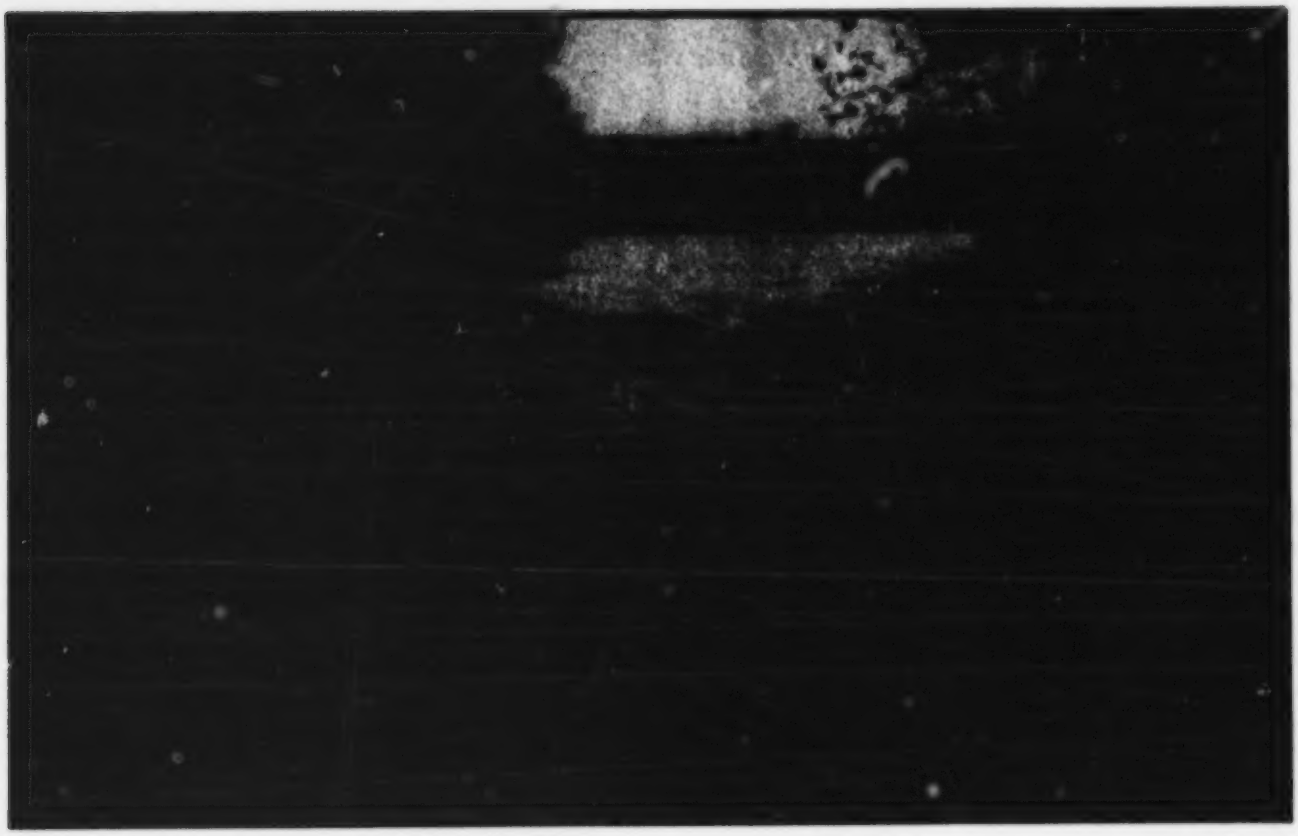
Environment Canada

A SUMMARY OF WATER MANAGEMENT DATA FOR THE RESTIGOUCHE RIVER BASIN

80-WPMB-3



WATER PLANNING AND MANAGEMENT BRANCH,
INLAND WATERS DIRECTORATE,
ATLANTIC REGION,
HALIFAX, NOVA SCOTIA

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80 - WPMB - 3

Water Planning and Management Branch
Inland Waters Directorate
Atlantic Region
Halifax, Nova Scotia

June 1980

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1. INTRODUCTION

The primary objective of this report is to consolidate all physical, environmental and socio-economic data available within the Department of Environment, Inland Waters Directorate, Atlantic Region, pertaining to the Restigouche River Basin, a transboundary basin located in the Provinces of New Brunswick and Quebec.

Data for the study has been obtained only from sources which were easily accessible within IWD, Atlantic. In some cases, the data has been derived from sources which are somewhat dated (eg. Montreal Engineering Water Resources Study of the Maritime Provinces). Where such sources were used, attempts were made to update the information, but it is likely that some deficiencies in this regard remain in the report, and the reader should interpret the information accordingly. In addition, much more data was available to the study for the New Brunswick portion of the Basin than for the Quebec side. Where this occurred, attempts were made to distinguish the areas to which the data applies.

The report first presents descriptions of the physical properties of the transboundary Basins, particularly the geology and climate. The distribution of the water resources data networks and selected socio-economic data are then illustrated to facilitate an interpretation of the resource base of the region. Flood prone areas are also identified and discussed because flood plain management is

a key element of any effective water management strategy. The forestry, fishery, and agricultural resources of the Basin are described because of their significant contributions to the economy of the area.

2. PHYSICAL DESCRIPTION OF THE BASIN

The Restigouche River Basin lies partly in New Brunswick and partly in Quebec. The river itself forms the boundary between Quebec and New Brunswick for about 80 kilometers.

Four main tributaries drain the Restigouche River Basin. These are: 1) the Matapedia, with a total drainage area of 3,830 kilometers, which lies wholly in Quebec and meets the main stem of the Restigouche River about 19 kilometers upstream from Campbellton; 2) the Patapedia, which lies mainly in Quebec and forms the Quebec-New Brunswick border for 29 kilometers; 3) the Upsalquitch, which flows in a northerly direction from the New Brunswick Highlands (the divide which separates the Restigouche Basin from the Nepisiguit Basin), and meets the Restigouche River about 19 kilometers upstream of Tide Head; 4) the Kedgwick, which originates in the Notre Dame Mountains in the north-west corner of the Restigouche Basin, and flows in a south-easterly direction until it intersects the main stem of the Restigouche River at Val Riopel.

The Restigouche River itself is tidal for about 40 kilometers upstream from its mouth, and navigable for small vessels for about 29 kilometers.

The following parameters were determined using 1:250,000 scale N.T.S. maps.

	Area to Mouth (sq. km.)	% Drainage Area in N. B.	% Drainage Area in Quebec
Kedgwick	1,584	80	20
Patapedia	919	13	87
Matapedia	3,734	--	100
Restigouche	13,028	51	49

Table 1 provides a listing of some of the physical characteristics of selected rivers within the Restigouche River Basin.

Three physiographic divisions of the Canadian Appalchia as depicted in Figure 1 are found in the Basin: 1) Notre Dame Mountains; 2) Chaleur Uplands, and 3) the New Brunswick Highlands.

Both the headwaters and the main stem of the Restigouche River itself lie in the Chaleur Uplands. The Matapedia, Patapedia and the Kedgwick Rivers rise in the Notre Dame mountains of Quebec, and the Upsalquitch River originates in the New Brunswick Highlands.

3. GEOLOGY

3.1 Surficial Geology

Nearly all of the New Brunswick portion of the Basin is either exposed bedrock or is covered by a thin veneer of glacial till. Towards the middle of this New Brunswick section, there are approximately 1,423 square kilometers of undifferentiated ablation and ground moraine

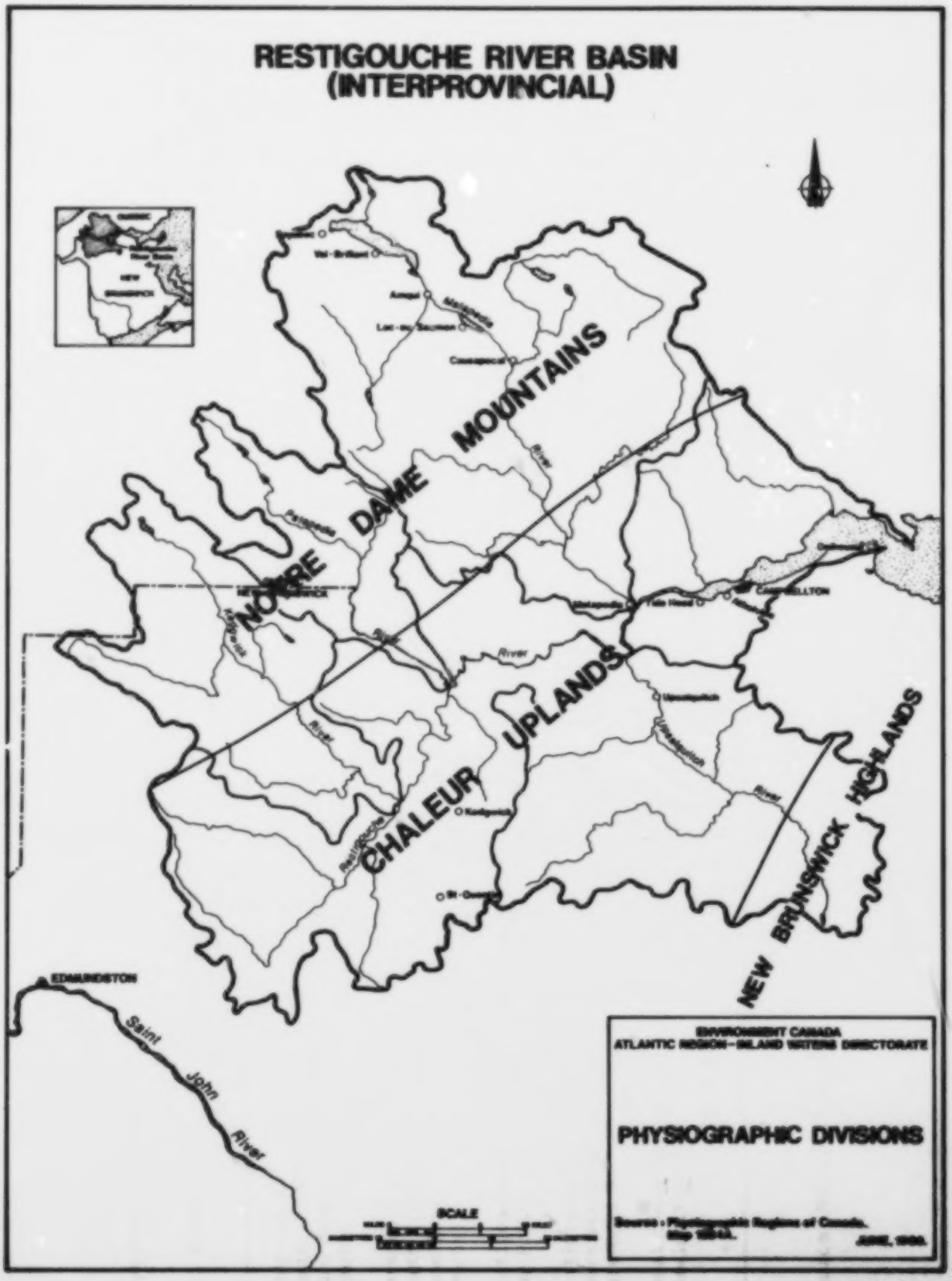
RESTIGOUCHE RIVER BASIN
(INTERPROVINCIAL)
NORTH
MOUNTAINS
DAME
CHALEUR
UPLANDS
NEW BRUNSWICK HIGHLANDS
EDMUNDSTON
Saint John River
CAMPBELLTON
ENVIRONMENT CANADA
ATLANTIC REGION - INLAND WATERS DIRECTORATE
PHYSIOGRAPHIC DIVISIONS
SCALE

TABLE 1

PHYSICAL CHARACTERISTICS OF RIVERS IN RESTIGOUCHE RIVER BASIN

River	Drainage Area (sq.km.)	Length (Meander) (km.)	Average Fall By Meander m./km.	Average Elevation m.	Area of Lakes % of D A	Area of Swamps % of D A	Total Area of Lakes & Swamps % of D A	Area Controlled by Lakes & Swamps % of D A
Kedgwick at Mouth (Confluence Restigouche)	1,584	90	2.71	354	0	0	0	0
Patapedia at Mouth (Confluence Restigouche)	919	92	8.90	334	0.66	0	0.66	13.2
Restigouche at Cow Pool	3,157	81	3.94	256	0	0	0	0
Restigouche above mouth of Matapedia R.	7,764	171	2.54	264	0	0.10	0.10	2
Upsalquitch at Upsalquitch	2,270	73.5	8.14	308	0.11	0.03	0.14	5

Source: NBCO, 1969

deposits (Meco, 1969). Ablation moraine is an uneven pile or continuous layer of till resting on ground moraine derived from the same glacier. "Undifferentiated" implies a single rock type derived from a common magma.

Large deposits of valley train outwash and kame terraces extend upstream of the Restigouche River from its confluence with the Patapedia and along several branches toward the Notre Dame Mountains. Valley train outwash consists of a long narrow body of material deposited by melt-water streams far beyond the terminal moraine of an active glacier in the past, and confined within the walls of a valley below the glacier. Kame terrace deposits are terrace-like ridges consisting of stratified sand and gravel deposited by a stream between a melting glacier and a higher valley wall or lateral moraine, and left standing after the disappearance of ice. A kame terrace terminates a short distance downstream from the terminal moraine.

Various forms of stream alluvial deposits (material deposited by running water in recent times) are found extending from Tide Head to Matapedia and along Christopher Brook.

Outwash and outwash-delta materials, the latter being sedimentary deposits laid down in a delta characterized by well developed local cross bedding and mixtures of sand, clay and organic materials, are found along the Restigouche estuary for seven miles downstream of Tide Head.

No information on surficial geology was readily available to this study regarding the Quebec portion of the Basin.

3.2 Bedrock Geology

The Restigouche drainage basin is underlain almost entirely by rocks of the Ordovician, Silurian and Devonian ages (Figure 2). These groups cover approximately 95% of the total area of the Basin.

Devonian age rocks are the most predominant, covering most of the Kedgwick, Patapedia and Matapedia River Basins. Silurian age rocks are located in three primary areas of the Basin. They form: 1) fingers cutting across the headwaters of the Kedgwick, Patapedia and Matapedia watersheds; 2) a wedge into the central Restigouche River Basin; and 3) a band through the centre of the Upsalquitch River Basin continuing to the mouth of the Restigouche River near Campbellton. The oldest bedrock (Cambrian and Ordovician) can be found in the Sayabec area of Quebec, with another small area located in the headwaters of the Upsalquitch River in New Brunswick. The remaining units, Carboniferous and Silurian-Devonian are located near Dalhousie and in the headwaters of the Upsalquitch River respectively.

There was no readily available information regarding any significant mineral deposits in the Restigouche River Basin in either New Brunswick or Quebec. Speculation mounted during the 1950's when base metal

FIGURE 2

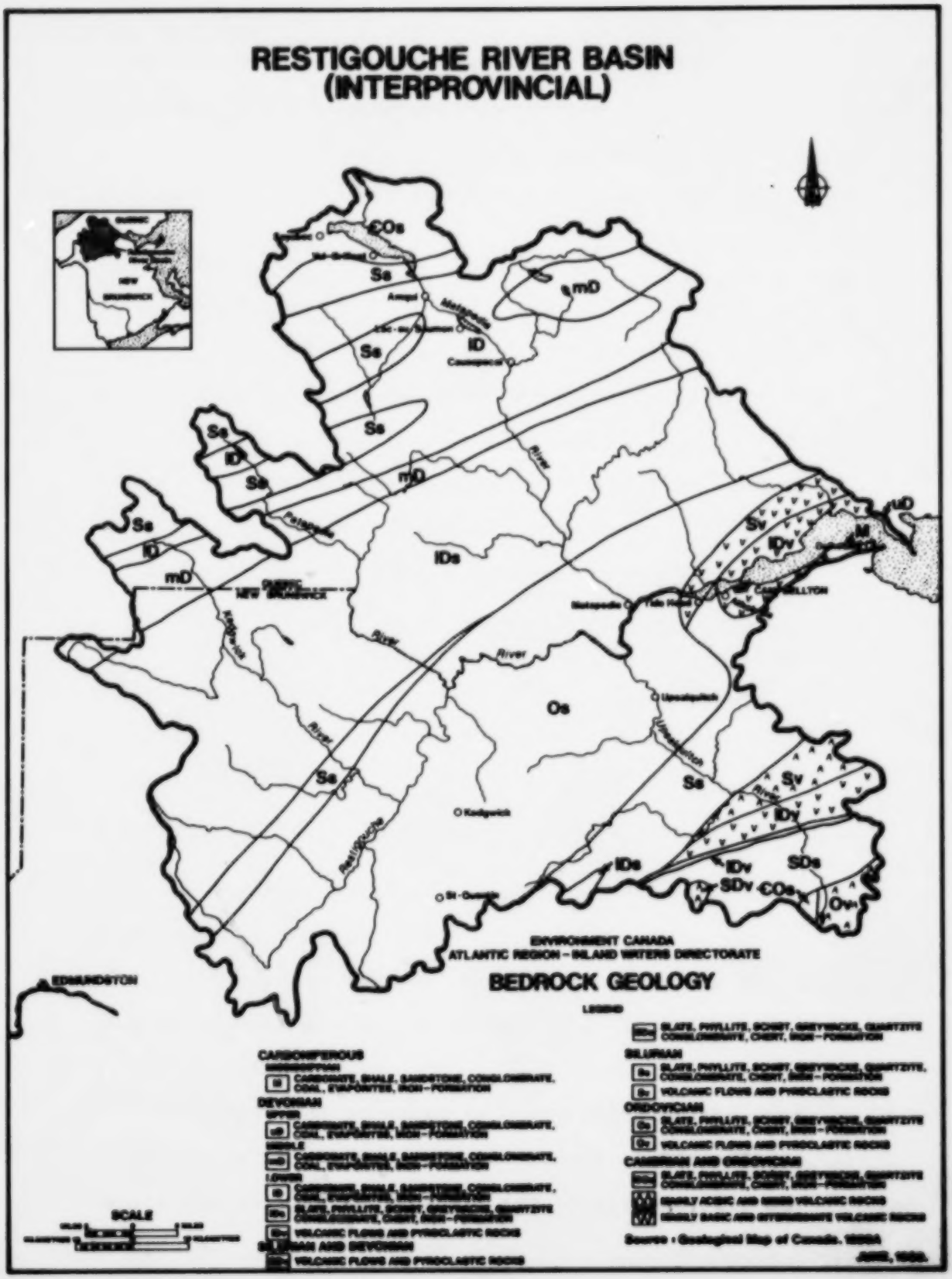
RESTIGOUCHE RIVER BASIN
(INTERPROVINCIAL)
ENVIRONMENT CANADA
ATLANTIC REGION - INLAND WATERS DIRECTORATE
BEDROCK GEOLOGY
LEGEND
CARBONIFEROUS
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN AND ORDOVICIAN
SILURIAN AND DEVONIAN
SCALE
EDMUNDSTON
Kedgwick
St-Quentin
Campbellton
Matapedia
Restigouche
Kedgwick River
Upsalquitch
Matapedia River
Patapedia River

FIGURE 2

deposits were located near the south east portion of the Basin and rich deposits were discovered in the Bathurst area. However, no mining developments of any significance have taken place within the Restigouche Basin.

4. CLIMATE

4.1 Temperature

Tables 2 through 5 summarize available temperature data in or near the Restigouche River Basin at the various official climatological stations.

From these tables it is apparent that mean daily January, July and annual temperatures are as follows:

	Temperatures (0_C)		
	Mean Daily January	Mean Daily July	Mean Annual
Edmundston, N. B.	-12.6	18.6	3.8
Kedgwick, N. B.	-13.2	16.4	2.0
Causapscal, Quebec	-13.6	17.2	2.4
Matapedia, Quebec	-12.5	17.9	3.3

The average annual temperature of the above stations is 2.9^0C (37.2^0F).

The range between the mean temperatures for the coldest and warmest months is 29.6^0C at Kedgwick and 30.4^0C at Matapedia.

Frost had occurred in every month of the year at Kedgwick; in all but July and August at Edmundston; in all but July at Causapscal; and in all but July at Matapedia.

FIGURE 3

RESTIGOUCHE RIVER BASIN
(INTERPROVINCIAL)
Matapedia River
Patapedia River
Restigouche River
Upsalquitch River
Campbellton
Dalhousie
Tide Head
Cascapedia
EDMUNDSTON
Saint John River
ENVIRONMENT CANADA
ATLANTIC REGION - INLAND WATERS DIRECTORATE
DATA COLLECTION NETWORK
LEGEND
CLIMATOLOGICAL STATIONS
HYDROMETRIC STATIONS
WATER QUALITY STATIONS
Source : Environment Canada.
JUNE, 1990
SCALE

FIGURE 3

TABLE 2

TEMPERATURE DATA RELATING TO THE RESTIGOUCHE RIVER BASIN

EDMUNDSTON, NEW BRUNSWICK

Period of Record: 15 to 19 years (and as indicated)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
No. of days with frost	31	28	30	20	7	1	0	0	4	13	24	30	188
Mean daily temperature °C	-12.6	-10.7	- 5.0	2.7	10.1	15.4	18.6	17.1	12.4	6.7	- 0.3	- 8.9	3.8
Mean daily maximum temperature °C	- 7.6	- 5.6	0.1	7.8	16.1	21.6	24.5	23.1	18.1	11.6	3.0	- 4.9	9.0
Mean daily minimum temperature °C	-17.6	-16.1	-10.2	- 2.3	4.1	9.2	12.6	11.1	6.6	1.8	- 3.6	-13.0	- 1.5
Extreme Maximum temperature °C	11.7	8.3	21.7	27.8	32.2	37.2	36.1	35.6	32.2	30.6	18.9	12.8	37.2
(years of record)	(39)	(38)	(39)	(37)	(37)	(38)	(37)	(38)	(39)	(38)	(37)	(39)	
Extreme minimum temperature °C	-40.6	-39.4	- 32.2	-18.9	- 7.2	- 4.4	1.7	0.0	- 7.2	-16.1	-25.6	-40.0	-40.6
(years of record)	(42)	(43)	(40)	(38)	(38)	(39)	(38)	(38)	(39)	(38)	(40)	(41)	

Source: Canadian Normals Vol. S-I

TABLE 3

TEMPERATURE DATA OF THE RESTIGOUCHE RIVER BASIN

KEDGWICK

Period of Record: 10 to 23 years

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
No. of days with frost	31	28	30	26	14	4	1	2	10	17	25	30	218
*Mean daily temperature °C	-13.2	-12.2	- 6.3	0.9	7.8	13.7	16.4	14.7	10.3	4.7	- 2.3	-10.5	2.0
Mean daily maximum temperature °C	- 8.3	- 5.5	0.1	6.8	14.1	20.7	23.6	21.3	16.9	9.7	2.2	- 5.4	8.1
* Mean daily minimum temperature °C	-18.2	-18.9	-12.7	- 5.1	1.1	6.6	9.2	8.1	3.7	- 0.4	- 6.8	-15.6	- 4.1
Extreme maximum temperature °C	7.2	10.0	13.9	23.9	30.6	33.9	33.3	36.7	31.1	25.6	18.3	12.8	36.7
Extreme minimum temperature °C	-41.7	-43.9	-38.3	-27.8	-15.0	- 6.7	- 2.2	- 3.9	-10.0	-13.9	-32.2	-41.1	-43.9

* - adjusted

Source: Canadian Normals Vol. S-I

TABLE 4

TEMPERATURE DATA OF THE RESTIGOUCHE RIVER BASIN

CAUSAPSCAL, QUEBEC

Period of Record: 30 years or more

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
No. of days with frost	31	28	31	25	13	2	-	1	7	16	25	30	209
Mean daily temperature °C	-13.6	-12.5	- 6.4	1.3	8.1	14.0	17.2	15.6	10.9	5.3	- 1.4	- 9.8	2.4
Mean daily maximum temperature °C	- 8.0	- 6.0	- 0.2	6.7	14.6	20.9	23.9	22.2	17.2	10.4	2.5	- 5.2	8.3
Mean daily minimum temperature °C	-19.2	-19.0	-12.7	- 4.3	1.4	7.1	10.3	8.9	4.7	0.1	- 5.2	-14.6	- 3.5
Extreme maximum temperature °C	11.3	11.1	19.4	29.4	32.8	33.3	35.6	34.4	32.8	26.7	19.4	13.9	35.6
(years of record)	(53)	(53)	(52)	(51)	(50)	(49)	(53)	(50)	(53)	(52)	(50)	(52)	
Extreme minimum temperature °C	-42.8	-41.7	-34.4	-23.9	-12.2	- 4.4	0.6	- 1.7	- 7.8	-13.9	-27.2	-40.0	-42.8
(years of record)	(53)	(53)	(52)	(51)	(48)	(48)	(51)	(52)	(54)	(51)	(51)	(53)	

Source: Canadian Normals Vol. S-I

TABLE 5

TEMPERATURE DATA OF THE RESTIGOUCHE RIVER BASIN

MATAPEDIA, QUEBEC

Period of Record: 10 to 30 years

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
No. of days with frost	31	28	30	24	11	2	0	-	5	17	25	30	203
Mean daily temperature °C	-12.5	-10.8	- 5.3	2.1	8.7	14.7	17.9	16.4	12.1	5.6	- 0.7	- 8.7	3.3
Mean daily maximum temperature °C	- 8.3	- 5.5	0.1	6.8	14.7	20.7	23.6	21.3	16.9	9.7	2.2	- 5.4	8.1
Mean daily minimum temperature °C	-18.1	-17.5	-11.7	- 3.5	2.3	7.8	10.9	9.3	5.3	0.1	- 4.4	-13.3	- 2.8
Extreme Maximum temperature °C	8.3	12.8	16.1	26.7	33.3	35.0	36.7	35.6	33.3	28.3	20.6	8.9	36.7
Extreme minimum temperature °C	-38.9	-40.6	-33.3	-20.6	-10.6	- 2.8	0.6	- 0.6	- 6.7	-11.1	-21.1	337.2	-40.6

Source: Canadian Normals Vol. S-I

4.2 Precipitation

Tables 6 through 9 list precipitation data recorded at the three climatological stations located within the Restigouche River Basin, and at Edmundston, New Brunswick, which lies outside of the Basin, but which has been included here because it is considered to be close enough to be representative of at least part of the Basin.

From the tables, it is apparent that the mean annual precipitation measurements at the four stations are as follows:

	Mean Annual Rainfall (mm)	Mean Annual Snowfall (cm)	Mean Annual Precipitation (mm)
Kedgwick	646.7	323.8	973.1
Matapedia	687.4	274.7	962.0
Causapscal	662.7	286.3	949.0
Edmundston	669.8	317.4	987.6

The average annual precipitation at the above stations is 967.7 mm (38.1 in.).

5. WATER RESOURCES

5.1 Surface Water Quantity

Table 10 indicates the mean annual, maximum instantaneous, maximum daily and minimum daily flows monitored at each of the hydrometric gauging sites located in the Basin for the appropriate period of record.

Sufficient quantities of surface water exist for hydroelectric power development, but the basin terrain is considered to be unsuitable for dam construction and water

TABLE 6

PRECIPITATION DATA RELATING TO THE RESTIGOUCHE RIVER BASIN, EDMUNDSTON, N.B.

Period of Record: 15 to 19 years (and as indicated)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
No. of days with Measurable precipitation	12	11	10	12	12	13	12	12	10	11	12	12	139
Mean monthly rainfall (mm)	7.6	4.1	9.1	46.5	79.5	106.7	97.8	89.2	82.3	75.9	53.6	17.5	669.8
Mean monthly snowfall (cm)	66.8	71.6	55.9	25.4	2.5	0.0	0.0	0.0	0.0	5.8	36.6	52.8	317.4
Mean monthly precipitation (mm)	74.4	75.7	65.0	71.9	82.0	106.7	97.8	89.2	82.3	82.0	90.2	70.4	987.6
Maximum 24-hour rainfall (mm) (years of record)	22.6 (41)	15.2 (38)	25.4 (40)	50.8 (34)	43.2 (33)	56.6 (32)	57.7 (31)	69.6 (33)	80.0 (32)	72.9 (35)	62.0 (32)	76.2 (42)	80.0
Maximum 24-hour snowfall (cm) (years of record)	68.6 (35)	69.9 (26)	38.1 (35)	27.9 (35)	16.5 (41)	1.3 (41)	0.0 (39)	0.0 (40)	4.1 (43)	19.3 (39)	55.1 (33)	45.7 (33)	69.9
Maximum 24-hour precipitation (mm) (years of record)	68.6 (34)	69.9 (26)	38.1 (35)	50.8 (30)	59.7 (32)	56.6 (32)	57.7 (31)	69.6 (33)	80.0 (32)	72.9 (33)	62.0 (30)	76.2 (33)	80.0

Source: Canadian Normals, Vol. 2 - SI

TABLE 7

PRECIPITATION DATA OF THE RESTIGOUCHE RIVER BASIN - KEDGWICK

Period of Record: 10 to 14 years (and as indicated)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
No. of days with Measurable precipitation	12	11	11	9	13	12	14	14	12	12	14	14	148
Mean monthly rainfall (mm)	4.6	10.2	11.9	23.4	70.6	87.1	97.0	95.5	86.9	100.6	40.6	18.3	646.7
Mean monthly snowfall (cm)	64.5	54.6	49.8	24.6	5.8	0.3	0.0	0.0	T	6.9	37.8	79.5	323.8
Mean monthly precipitation (mm)	69.1	65.0	61.5	48.0	77.0	87.4	97.0	95.5	87.1	107.4	80.3	97.8	973.1
Maximum 24-hour rainfall (years of record)	21.6 (17)	29.2 (17)	23.9 (18)	29.5 (17)	42.2 (21)	69.9 (23)	52.3 (23)	54.1 (22)	84.3 (21)	91.9 (18)	43.2 (7)	22.6 (8)	91.9
Maximum 24-hour snowfall (cm) (years of record)	40.6 (17)	40.6 (17)	30.5 (18)	17.8 (18)	30.5 (22)	2.8 (23)	0.0 (24)	0.0 (23)	1.3 (23)	15.2 (19)	25.4 (6)	40.6 (8)	40.6
Maximum 24-hour precipitation (mm) (years of record)	40.6 (17)	40.6 (17)	30.5 (18)	29.5 (17)	42.2 (21)	69.9 (23)	52.3 (24)	54.1 (22)	84.3 (21)	91.9 (18)	44.5 (7)	40.6 (8)	91.9

Source: Canadian Normals Vol. 2 - SI

TABLE 8

PRECIPITATION DATA OF THE RESTIGOUCHE RIVER BASIN - CAUSAPSCAL, QUEBEC

Period of Record: 25 to 29 years (and as indicated)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
No. of days with Measurable precipitation	12	11	9	8	11	12	12	11	11	10	13	13	133
Mean monthly rainfall (mm)	11.2	8.4	11.9	39.4	70.1	87.9	109.7	85.1	92.2	72.9	58.4	15.5	662.7
Mean monthly snowfall (cm)	62.2	58.7	52.3	14.2	1.5	0.0	0.0	0.0	0.3	6.4	28.2	62.5	286.3
Mean monthly precipitation (mm)	73.4	67.1	64.0	53.6	71.6	87.9	109.7	85.1	92.5	79.2	86.9	78.0	949.0
Maximum 24-hour rainfall (mm)	78.2	31.0	57.2	58.4	57.9	53.8	86.4	60.7	78.2	76.2	56.9	54.1	86.4
(years of record)	(54)	(52)	(48)	(46)	(50)	(53)	(53)	(51)	(53)	(53)	(50)	(51)	
Maximum 24-hour snowfall (cm)	40.6	30.5	38.1	30.5	7.6	2.0	0.0	0.0	6.4	30.5	20.3	61.0	61.0
(years of record)	(54)	(54)	(48)	(47)	(50)	(53)	(53)	(52)	(54)	(53)	(50)	(57)	
Maximum 24-hour precipitation (mm)	78.2	31.0	57.2	58.4	57.9	53.8	86.4	60.7	78.2	76.2	56.9	61.0	86.4
(years of record)	(54)	(52)	(47)	(46)	(50)	(53)	(53)	(51)	(53)	(53)	(50)	(51)	

Source: Canadian Normals Vol. 2 - SI

TABLE 9

PRECIPITATION DATA OF THE RESTIGOUCHE RIVER BASIN - MATAPEDIA

Period of Record: 15 to 19 years (and as indicated)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
No. of days with Measurable precipitation	8	7	7	8	9	11	11	10	8	9	9	9	106
*Mean monthly rainfall (mm)	8.1	4.6	14.2	39.9	76.7	88.9	89.2	99.3	81.8	94.0	61.5	29.2	687.4
*Mean monthly snowfall (cm)	61.0	63.0	53.1	17.3	1.8	0.0	0.0	0.0	T	4.1	23.6	50.8	274.7
*Mean monthly precipitation (mm)	69.1	67.6	67.3	57.2	78.5	88.9	89.2	99.3	81.8	98.0	85.1	80.0	962.0
Maximum 24-hour rainfall (mm)	45.2	24.1	76.2	30.5	45.5	63.0	55.9	63.5	127.0	58.9	52.1	50.8	127.0
(years of record)	(29)	(29)	(29)	(22)	(24)	(23)	(26)	(25)	(23)	(23)	(21)	(21)	
Maximum 24-hour snowfall (cm)	45.7	68.6	38.1	33.0	5.8	0.0	0.0	0.0	1.3	20.3	30.5	45.7	68.6
(years of record)	(24)	(24)	(24)	(26)	(33)	(32)	(34)	(33)	(31)	(28)	(20)	(19)	
Maximum 24-hour precipitation (mm)	45.7	68.6	76.2	33.0	45.5	63.0	55.9	63.5	127.0	58.9	52.1	50.8	127.0
(years of record)	(24)	(23)	(23)	(21)	(24)	(23)	(26)	(25)	(23)	(23)	(19)	(18)	

* Adjusted

Source: Canadian Normals - Vol. 2 - SI

TABLE 10

FLOW CHARACTERISTICS OF THE RESTIGOUCHE RIVER BASIN

RIVER	W.S.C. IDENTIFICATION #	STARTED OPERATIONS (YR)	DRAINAGE AREA (sq. km.)	CMS PER SQUARE KILOMETER				Period of Record[b]
				Mean Annual	Maximum Instantaneous	Maximum daily	Minimum Daily	
Restigouche	01BA001	1973	1,571	.02 (36)	—	.43 (95)	.0032 (79)	4
Restigouche	01BJ007	1968	7,741	.02 (26)	.39 (85)	.33 (60)	.0020 (77)	8
Restigouche	01BC001	1962	3,158	.02 (10)	.41 (85)	.35 (31)	.0020 (77)	14
Upsalquitch	01BE001	1918	2,270	.01 (81)	.30 (92)	.29 (67)	.0009 (84)	58
Matapedia	001507[a]	1968	2,270	.02 (02)	.23 (60)	.22 (17)	.0017 (49)	7

[a] Province of Quebec Identification Number

[b] CFS per square mile is based on appropriate period of record

storage. Several potential storage and power plant sites have been investigated in the past, but none was considered to be economically feasible (MECO, 1969).

5.2 Surface Water Quality

Water samples analysed in 1954 and 1955 from the main stem of the Restigouche River near Matapedia, from the Upsalquitch River at Upsalquitch, and from the Matapedia River near Matapedia, revealed that the water was chemically satisfactory and non-corrosive. Hardness ranged from medium to hard, and the color and turbidity parameters were also rated low (MECO, 1969).

Tables 11 and 12 summarize water quality data on water samples collected at two water quality stations in the New Brunswick portion of the Basin from 1961 to 1976. Table 13 shows water quality data from a station on the Matapedia River in the Quebec portion of the Basin. No other data was available to this study regarding water quality on the Quebec side.

A number of other water quality stations currently exist within the Basin. However, the data from these stations has not been published and has, therefore, been excluded from this report.

5.3 Groundwater Quantity

Due to a lack of information, yields from surficial wells have been estimated using only the type of surficial deposits of materials comprising the aquifers. These estimates should be interpreted as average ranges

TABLE 11

WATER QUALITY DATA

1961-1976 (Summary)

STATION 00NB01BC0001 LAT. 47D 39M 59S LONG. 67D 29M 36S
RESTIGOUCHE RIVER AT HWY BRIDGE BELOW KEDGWICK RIVER (WSC GAUGE)
RESTIGOUCHE COUNTY

	SPECIFIC CONDUCTANCE	OXYGEN DISSOLVED DO O2	TURBIDITY	COLOUR APPARENT	ALKALINITY PHENOL PHTALE IN CAC03	ALKALINITY TOTAL CAC03	PH
	USIE/CM	MG/L	JTU	REL. UNITS	MG/L	MG/L	PH UNITS
SAMPLES	63	7	63	63	63	63	62
LOW	57	9.6	L.1	L5	0.0	[illegible]	7.0
HIGH	210	13.6	20.0	59	0.5	99.9	8.2
AVERAGE	153	12.3	1.6	9	0.0	70.8	
STD.DEV.	27	1.3	3.1	9	0.1	17.1	
PERCNT:10TH	127		L.1	9	0.0	54.0	7.2
25TH	137	12.2	0.2	5	0.	64.0	7.5
MEDIAN 50TH	153	12.6	0.5	5	0.0	72.5	7.7
75TH	166	13.2	1.4	10	0.	80.7	7.9
90TH	189		4.0	15	0.0	89.0	8.0

Table 11 continued .....

Table 11 (continued)

	SATURATION INDEX (CALCO.) PH UNITS	STABILITY INDEX (CALCO.) PH UNITS	SODIUM ADSORPTION RATIO REL. UNITS	TOTAL DISSOLVED SOLIDS (CALCO.) MG/L	POTASSIUM DISSOLVED K MG/L	SODIUM DISSOLVED NA MG/L	CALCIUM DISSOLVED CA MG/L
SAMPLES	60	60	63	61	62	63	63
LOW	-2.3	7.7	0.06	36	0.2	1.0	6.0
HIGH	0.2	11.0	0.05	110	1.3	3.9	37.5
AVERAGE			0.09	81	0.4	1.7	26.5
STD.DEV.			0.04	16	0.2	0.4	5.5
PERCNT: 10TH	-1.0	8.1	0.07	63	0.3	1.3	21.5
25TH	-0.7	8.3	0.08	73	0.4	1.5	23.5
MEDIAN 50TH	-0.5	8.5	0.08	82	0.4	1.7	25.0
75TH	-0.2	8.0	0.09	90	0.5	1.9	30.0
90TH	-0.1	9.0	0.10	101	0.6	2.1	34.3

	MAGNESIUM DISSOLVED MG MG/1	CARBONATE (CALCO.) CO3 MG/L	BICARBONT. (CALCO.) HC03 MG/L	CHLORIDE DISSOLVED CL MG/L	SULPHATE DISSOLVED SO4 MG/L	HARDNESS TOTAL (CALCO.) CAC03 MG/L	NITROGEN DISSOLVED NO3 & NO2 N MG/L
SAMPLES	44	62	62	62	62	44	63
LOW	1.9	0	27	0.8	2.0	34.0	0.014
HIGH	4.5	0	122	5.5	13.2	108.4	1.16
AVERAGE	2.8	0	38	1.4	5.9	79.9	0.30
STD.DEV.	0.5	0	18	0.8	1.8	12.9	0.19
PERCNT: 10TH	2.2	0	67	0.9	4.6	62.8	0.090
25TH	2.6	0	78	0.9	6.0	72.3	0.160
MEDIAN 50TH	2.9	0	89	1.1	5.7	78.5	0.240
75TH	3.1	0	98	1.5	6.7	83.8	0.400
90TH	3.4	0	108	2.0	7.2	99.2	0.52

Table 11 (Continued)

	NITROGEN DISSOLVED AMMONIA N MG/L	NITROGEN TOTAL KJELDAHL N MG/L	PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	PHOSPHORUS TOTAL P MG/L	CARBON TOTAL INORGANIC C MG/L	CARBON TOTAL ORGANIC C MG/L	SILICA REACTIVE SIO2 MG/L
SAMPLES	25	2	26	8	2	7	60
LOW	L.0	L.5	L.002	0.002	9.5	L.5	2.1
HIGH	0.5	L.5	0.110	0.13	14.5	7.5	7.5
AVERAGE	0.1		0.016	0.02	12.0	3.8	4.8
STD.DEV.	0.1		0.021	0.04	3.5	2.3	1.6
PERCNT: 10TH	0.0		L.002				3.6
25TH	L.1		L.005	0.005		2.4	4.2
MEDIAN 50TH	L.1	L.5	0.010	0.008	12.0	3.6	5.6
75TH	0.1		0.016	0.015		5.7	5.4
90TH	0.2		0.023				6.1

	FLUORIDE DISSOLVED F MG/L
SAMPLES	27
LOW	L.05
HIGH	0.11
AVERAGE	0.08
STD.DEV.	0.02
PERCNT: 10TH	L.05
25TH	L.05
MEDIAN 50TH	L.10
75TH	L.10
90TH	0.10

TABLE 11 (Cont'd.)

	RESIDUE NONFILTR. MG/L	RESIDUE FIXED NONFILTR. MG/L	RESIDUE FILTERABLES MG/L	RESIDUE FIXED FILTERABLE MG/L	OXYGEN CONSUMED MG/L	CHROMIUM EXTRBLE. CR MG/L	MANGANESE DISSOLVED MN MG/L
SAMPLES	6	5	5	5	11	2	19
LOW	8	L1	83	25	0.9	L.0005	L.010
HIGH	68	34	86	71	10.6	0.0100	L.010
AVERAGE	30	14	84	50	3.7	0.0050	
STD.DEV.	22	13	1	19	2.8	0.0070	
PERCNT: 10TH					1.1		L.010
25TH	11	5	84	36	1.8		L.010
MEDIAN 50TH	27	16	84	54	2.9	0.0050	L.010
75TH	38	16	84	64	5.1		L.010
90TH					5.8		L.010

Table 11 continued .....

Table 11 (continued)

		MANGANESE EXTRBLE. MN MG/L	IRON DISSOLVED FE MG/L	IRON EXTRBLE. FE MG/L	COBALT EXTRBLE. CO MG/L	NICKEL EXTRBLE. NI MG/L	COPPER EXTRBLE. CU MG/L	ZINC EXTRBLE. ZN MG/L
SAMPLES		25	13	25	2	2	45	45
LOW		L.01	L.001	L.001	0.004	0.015	L.001	L.001
HIGH		0.05	0.060	0.820	0.004	0.040	0.200	0.080
AVERAGE		0.01	0.016	0.122	0.004	0.028	0.020	0.010
STD.DEV.		0.01	0.019	0.178	0.000	0.018	0.044	0.010
PERCNT:	10TH	L.01	L.001	0.030			L.001	L.001
	25TH	L.01	L.001	0.040			L.001	0.003
MEDIAN	50TH	L.01	0.010	0.060	0.004	0.028	L.002	0.007
	75TH	0.01	0.020	0.120			0.010	0.014
	90TH	0.02	0.060	0.250			0.060	0.030

		ARSENIC TOTAL AS MG/L	CADMIUM EXTRBLE. CD MG/L	MERCURY EXTRBLE. HG UG/L	LEAD EXTRBLE. PB MG/L
SAMPLES		2	20	10	36
LOW		L.005	L.001	L.05	L.001
HIGH		0.005	0.002	0.92	0.070
AVERAGE		0.005	0.001	0.14	0.005
STD.DEV.		0.000	0.000	0.28	0.011
PERCNT:	10TH		L.001	L.05	L.001
	25TH		L.001	L.05	L.001
MEDIAN	50TH	0.005	L.001	L.05	0.002
	75TH		0.001	0.05	0.005
	90TH		0.001	0.49	0.010

Source: Water Quality Data, New Brunswick, 1961-1977
Inland Waters Directorate
Water Quality Branch
Ottawa, Canada 1979

TABLE 12

WATER QUALITY DATA

1961-1976 (SUMMARY)

STATION 00NB01BE0001 LAT. 47D 49M 57S LONG. 66D 53M 11S
UPSALQUITCH RIVER AT R. R. BRIDGE (WSC GAUGE), UPSALQUITCH STATION
RESTIGOUCHE COUNTY

	SPECIFIC CONDUCTANCE USIE/CM	OXYGEN DISSOLVED 02 MG/L	TURBIDITY JTU	COLOUR APPARENT REL. UNITS	ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	ALKALINITY TOTAL CACO3 MG/L	PH PH UNITS
SAMPLES	100	6	100	100	100	99	100
LOW	15	9.5	L.1	L5	0.0	28.6	2.9
HIGH	191	13.8	57.0	50	0.0	96.4	8.2
AVERAGE	145	12.3	3.7	9	0.0	67.0	
STD.DEV.	29	1.5	9.5	8	0.0	12.8	
PERCNT: 10TH	114		0.1	L5	0.0	46.2	7.2
25TH	133	12.3	0.2	5	0.0	60.9	7.6
MEDIAN 50TH	148	12.5	0.6	5	0.0	70.1	7.8
75TH	164	13.4	1.4	10	0.0	76.0	8.0
90TH	174		10.5	18	0.0	80.6	8.1

Table 12 continued .....

Table 12 (continued)

	SATURATION INDEX (CALCD.) PH UNITS	STABILITY INDEX (CALCD.) PH UNITS	SODIUM ABSORPTION RATIO REL. UNITS	TOTAL DISSOLVED SOLIDS (CALCD.) MG/L	POTASSIUM DISSOLVED K MG/L	SODIUM DISSOLVED NA MG/L	CALCIUM DISSOLVED CA MG/L
SAMPLES	99	99	100	99	100	100	99
LOW	-5.1	7.8	0.03	45	0.1	1.0	2.6
HIGH	0.2	13.2	0.34	242	2.4	5.3	33.6
AVERAGE			0.10	80	0.5	1.9	24.3
STD.DEV.			0.04	20	0.3	0.7	4.7
PERCNT: 10TH	-1.2	8.1	0.07	61	0.3	1.3	17.8
25TH	-0.8	8.3	0.08	71	0.4	1.6	22.8
MEDIAN 50TH	-0.5	8.7	0.09	81	0.4	1.9	25.2
75TH	-0.2	9.1	0.10	86	0.5	2.0	27.0
90TH	0.0	9.7	0.11	92	0.7	2.2	28.6

	MAGNESIUM DISSOLVED MG MG/L	CARBONATE (CALCD.) CO3 MG/L	BICARBONT. (CALCD.) HCO3 MG/L	CHLORIDE DISSOLVED CL MG/L	SUPLHATE DISSOLVED SO4 MG/L	HARDNESS TOTAL (CALCD.) CACO3 MG/L	NITROGEN DISSOLVED NO3 & NO2 N MG/L
SAMPLES	54	99	99	99	100	54	97
LOW	0.9	0	35	0.1	L1.0	41.5	L.005
HIGH	4.0	0	118	11.0	24.0	91.1	1.11
AVERAGE	2.9	0	82	1.2	7.1	73.1	0.10
STD.DEV.	0.5	0	16	1.5	2.3	10.8	0.14
PERCNT: 10TH	2.2	0	56	0.6	5.6	55.7	L.005
25TH	2.6	0	74	0.8	6.3	69.0	0.018
MEDIAN 50TH	3.0	0	85	0.9	6.8	76.8	0.063
75th	3.1	0	93	1.2	7.8	80.2	0.156
90TH	3.4	0	98	1.9	8.9	82.9	0.220

Table 12 (continued)

	NITROGEN TOTAL KJELDAHL N MG/L	PHOSPHORUS DISSOLVED INORG. PO4 P MG/L	PHOSPHORUS TOTAL P MG/L	CARBON TOTAL INORGANIC C MG/L	CARBON TOTAL ORGANIC C MG/L	SILICA REACTIVE SIO2 MG/L	FLUORIDE DISSOLVED F MG/L
SAMPLES	2	41	9	2	7	97	43
LOW	L.5	L.002	L.001	10.5	1.4	0.3	L.05
HIGH	L.5	0.135	0.076	13.5	6.5	9.0	0.33
AVERAGE		0.012	0.016	12.0	3.6	5.7	0.10
STD.DEV.		0.022	0.023	2.1	1.7	1.2	0.06
PERCNT: 10TH		L.002	L.001			4.5	L.05
25TH		L.002	L.005		2.1	5.3	0.08
MEDIAN 50TH	L.5	L.005	0.006	12.0	3.5	5.8	L.10
75TH		0.013	0.020		4.3	6.4	L.10
90TH		0.030	0.075			6.9	0.12

TABLE 12 (Cont'd.)

	RESIDUE NONFILTR. MG/L	RESIDUE FIXED NONFILTR. MG/L	RESIDUE FILTERABLE MG/L	RESIDUE FIXED FILTERABLE MG/L	OXYGEN CONSUMED 02 MG/L	ALUMINIUM DISSOLVED AL MG/L	CHROMIUM EXTRBLE. CR MG/L
SAMPLES	3	2	7	5	29	5	2
LOW	L10	113	56	23	L.5	0.02	L.0005
HIGH	200	180	120	110	6.1	0.06	0.0090
AVERAGE	114	147	85	59	2.5	0.04	0.0050
STD.DEV.	96	47	20	32	1.5	0.02	0.0060
PERCNT: 10TH					0.8		
25TH			71	47	1.6	0.03	
MEDIAN 50TH	133	147	88	51	2.0	0.05	0.0050
75TH			94	64	3.0	0.06	
90TH					5.0		

Table 12 continued .....

Table 12 (continued)

	MANGANESE DISSOLVED MN MG/L	MANGANESE EXTRBLE. MN MG/L	IRON DISSOLVED FE MG/L	IRON EXTRBLE. FE MG/L	COBALT EXTRBLE. CO MG/L	NICKEL EXTRBLE. NI MG/L	COPPER EXTRBLE. CU MG/L
SAMPLES	27	39	27	40	2	2	37
LOW	L.010	0.01	L.001	L.001	0.004	0.011	L.001
HIGH	0.010	0.07	0.030	0.630	0.004	0.050	0.100
AVERAGE	0.010	0.02	0.009	0.115	0.004	0.031	0.020
STD.DEV.	0.000	0.61	0.010	0.166	0.000	0.028	0.030
PERCNT: 10TH	L.010	L.01	L.001	L.001			L.001
25TH	L.010	L.01	L.001	0.025			0.002
MEDIAN 50TH	L.010	L.01	L.001	0.050	0.004	0.031	L.010
75TH	L.010	0.02	0.020	0.115			0.020
90TH	0.010	0.04	0.020	0.350			0.070

	ZINC EXTRBLE. ZN MG/L	ARSENIC TOTAL AS MG/L	CADMIUM EXTRBLE. CD MG/L	MERCURY EXTRBLE. HG UG/L	LEAD EXTRBLE. PB MG/L
SAMPLES	37	2	13	10	19
LOW	L.001	L.005	L.001	L.05	L.001
HIGH	0.270	L.005	L.01	1.28	0.009
AVERAGE	0.020		0.00	0.19	0.003
STD.DEV.	0.040		0.00	0.39	0.002
PERCNT: 10TH	L.002		L.001	L.05	L.001
25TH	0.007		L.001	L.05	L.001
MEDIAN 50TH	L.010	L.005	L.001	L.05	0.002
75TH	0.020		L.001	0.09	0.004
90TH	0.041		0.002	0.73	0.006

Source: Water Quality Data, New Brunswick, 1961-1977 Inland Waters Directorate Water Quality Branch Ottawa, Canada 1979

TABLE 13 (continued)

TABLE 13

Water Quality Data

1967-1969

MATAPEDIA
At the Highway Bridge at Saint Alexis
Station Number 01150A
Drainage Area: 3,730 sq. km.
Equipment: Manually operated Sampler

Physical-Chemical Properties (Mg/l)

Sampling Dates	Flow Cu Ft/Sec	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonates (HCO_3)	Sulphate (SO_4)	Chlorides (Cl)	Fluorides (F)	Nitrates (NO_3)	Dissolved Solids	Hardness (Ca, Mg)	Hardness Non-Carbonates	Conductivity Microohms at 25°C	PH	Colour Units	Dissolved oxygen
1967																			
26 Nov.	-	-	0.08	33.0	0.9	1.8	0.5	92	-	6.5	0.0	0.0	97	86	10	168	6.9	4	-
15 Dec.	-	-	0.02	31.0	6.3	6.3	0.4	123	-	0.3	0.0	0.5	122	104	4	202	8.1	2	-
26 Jan.68	-	-	0.08	29.0	3.0	2.0	0.4	88	12.5	1.0	0.1	2.0	122	85	13	160	6.7	5	-
29 Feb.	-	-	0.06	38.0	1.5	3.1	1.3	123	4.5	0.5	0.1	1.5	93	101	1	213	6.6	0	-
10 Jul	-	-	0.28	26.5	1.8	2.0	0.4	90	4.0	0.5	0.1	0.0	91	74	0	158	7.8	8	-
11-20 Jul	-	-	0.22	27.0	1.8	1.9	0.4	90	4.5	0.5	0.0	1.0	97	75	1	158	7.9	15	-
21-29 Jul	-	-	0.34	27.0	1.5	1.9	0.4	88	6.0	0.5	0.0	0.0	92	74	1	158	8.0	15	-
30-31 Jul	-	-	0.06	27.0	0.9	2.0	0.5	85	5.0	0.0	0.2	1.0	97	71	1	153	7.8	15	-
1-10 Aug	-	-	0.06	27.0	1.8	2.1	0.5	89	7.0	0.0	0.2	0.5	91	78	5	165	7.8	3	-
11-20 Aug	-	-	0.06	27.0	2.1	2.1	0.6	90	5.0	0.0	0.2	1.0	92	80	6	162	7.8	3	-
21-31 Aug	-	-	0.06	27.0	2.1	2.0	0.5	90	6.5	0.0	0.3	0.5	90	76	2	164	7.8	3	-
1-7 Sept.	-	-	0.06	27.5	2.4	2.0	0.5	90	6.5	0.0	0.2	1.0	82	79	5	168	7.8	10	-
8-10 Sept.			0.50	28.5	2.4	1.9	0.4	88	6.5	1.0	0.2	0.0	109	82	10	166	7.2	19	-
11-20 Sept.			0.50	28.5	2.4	2.3	0.5	90	6.0	1.0	0.2	0.0	97	78	4	167	7.2	3	-
21-27 Sept.	-	-	0.34	27.5	2.1	2.0	0.5	95	5.0	1.0	0.2	0.0	113	81	3	172	7.2	8	-
28-30 Sept.	-	-	0.28	27.0	3.3	1.9	0.4	99	6.0	0.0	0.1	0.0	123	83	2	173	7.4	3	-
1-10 Oct	-	-	0.12	28.0	3.0	2.0	0.5	100	6.5	0.0	0.2	0.0	124	83	2	175	7.4	3	-
11-17 Oct	-	-	0.12	28.0	3.0	1.9	0.4	99	6.0	0.0	0.2	0.0	127	84	2	178	7.4	3	-
18-20 Oct	-	-	0.06	28.5	3.0	2.0	0.5	88	5.5	0.0	0.1	0.0	114	73	0	156	7.4	8	-
21-31 Oct	-	-	0.06	24.5	2.7	2.0	0.5	88	7.5	0.0	0.1	0.0	115	72	3	153	7.4	5	-
1-6 Nov.	-	-	0.00	24.5	2.4	1.8	0.4	84	5.5	0.0	0.2	0.0	125	78	1	166	7.4	5	-
7-16 Nov.	-	-	0.06	26.5	2.7	1.9	0.4	93	5.5	2.5	0.0	0.0	93	85	2	183	7.5	2	-
17-26 Nov.	-	-	0.00	28.0	3.6	2.5	0.5	101	5.5	1.5	0.0	1.0	89	87	3	183	7.7	3	-
27 Nov-11 Dec	-	-	0.06	28.5	3.6	2.0	0.4	102	5.0	2.0	0.0	0.3	92	91	5	194	7.6	3	-
12-26 Dec.	-	-	0.06	29.0	4.5	2.2	0.5	105	6.5	2.5	0.0	0.3	100	93	5	196	7.7	3	-
27 Dec.-5 Jan 68	-	-	0.06	30.5	3.9	2.2	0.4	107	6.5	2.0	0.0	0.5	103	93	5	196	7.8	5	-
			0.12	30.0	4.2	2.2	0.5	107	7.0	2.0	0.0								

Note: The accuracy of sulfatesis in the vicinity of ± 30% for concentrations below 20 ppm

Source: Qualite Des Eaux, 1968

which may not apply in all cases.

Valley train outwash and kame terrace deposits found along the Restigouche River and several of its branches have a theoretic yield of between 45 and 450 lpm; whereas larger aquifers could theoretically yield from 2,275 to 6,370 lpm. Two surficial wells supplying the Village of Atholville for many years have been rated at 783 and 1,138 lpm respectively (MECO, 1969).

No information on surficial wells in the Quebec portion of the Basin was available to this study.

Devonian and older granitic rocks typically yield between 5 and 68 lpm per well. Sedimentary formations found in the area between Richardsville and Maple Green could yield 5-68 lpm. Pennsylvanian or younger rocks may yield up to 900 lpm.

The community of Tide Head is supplied by a network of artesian wells. Groundwater is pumped from the wells to a reservoir, and is then distributed to the community. No data is available at this time regarding the yields of these wells.

5.4 Groundwater Quality

In general, data on groundwater quality was not available to this study. However, some insights can be obtained by referring to the Montreal Engineering Study of the Water Resources of the Maritime Provinces.

Water quality in surficial wells supplying the Village of Atholville has been consistently good, and re-

quires no treatment except for disinfection by chlorine. Total hardness ranged from 121 to 172 ppm and the chloride concentration was approximately 13 ppm. The hydrogeology map of the New Brunswick portion of the Restigouche Basin rated the surficial water quality as fair to good (MECO, 1969). No information was available concerning the Quebec portion of the Basin.

A meagre amount of information is available on water quality from bedrock wells, none of which relates to the Quebec side. Eight well samples from Tide Head gave high nitrate results, with hardness ranging from 93 to 240 ppm (MECO, 1969). Nevertheless, the quality of water from the artesian wells supplying Tide Head was reported as good. The hydrogeology map of the Restigouche River Basin rated the bedrock water quality from good to variable.

6. SOCIO-ECONOMIC CHARACTERISTICS

Historically, the economy of the Restigouche River Basin has depended to a great extent on the primary industries, especially forestry. Today the forestry sector remains the largest employer and contributes significantly to the area's economy and the economic health of the Basin will probably continue to depend on its pulp and paper mills. Nevertheless, in recent years the future of these mills, has been in doubt for a variety of financial reasons. Moreover, while the pulp mills at Atholville and Dalhousie remain the largest employers, they also

Table 12 (continued)

remain the largest polluters in the Basin.

Data for this section of the report has been derived primarily from information provided by Statistics Canada. Because this data is not typically aggregated by drainage areas, the 1971 User Summary Tapes have been used. These tapes provide detailed census information on demographic, family, economic and household characteristics, disaggregated to the enumeration area level. Because this data was gathered during the 1971 census and is therefore somewhat dated, care should be exercised in interpreting it. Another problem encountered was that the boundaries of the enumeration area, the smallest census unit, change from census to census to reflect changes in local population densities. Because of these boundary changes, comparing populations between census years is somewhat difficult.

Since a great deal of census data is published at the electoral district level, it was often more useful to use data at this level of aggregation than it was to attempt to interpret the enumeration area data. The particular ED's involved in this case are Restigouche, Bonaventure and Matapedia. Although none of the County boundaries conform to those of the Basin, it was felt that data from these counties would adequately reflect the economic characteristics of the Basin in many cases. As a result, this data has been incorporated below.

On the New Brunswick side, the Restigouche Basin includes the bulk of Restigouche County as well as small portions of Madawaska, Victoria, and Northumberland. In Quebec, the Basin includes most of Matapedia County, as well as portions of Bonaventure, Matane and Rimouski. In terms of population, Restigouche, Matapedia and Bonaventure are the most important. Consequently, most of the data presented below focuses on these three counties. For the purpose of this study, the Restigouche River Basin has been disaggregated into seven sub-basins. They are:

New Brunswick
1) Restigouche River (mouth to Patapedia confluence)
2) Kedgwick
3) Patapedia
4) Restigouche River (upstream of Patapedia confluence)
5) Upsalquitch River

Quebec
6) Matapedia
7) Kempt - Escuminac

The Restigouche River Basin in this study has been defined to the mouth of the river. This is because the majority of economic activity in the Basin is closely related to activities in Campbellton and Dalhousie. Because these two communities are the focus of the Restigouche Basin economy, the basin boundaries have been extended to include the estuary. A major reference used during the preparation of this report was the MECO study

done as part of the water resources study of the Maritime Provinces. In the study, the estuary portion was not included as part of the Restigouche Basin. Their definition extended only to the head of tide. Although both definitions are correct, because of the importance of the estuary area, the interpretation of socio-economic data presented below for the Basin should be made with care.

6.1 Population

In 1971, the population of the Restigouche River Basin was about 57,285. Of this amount, 29,538 (52%) lived in the Quebec portion of the Basin and 27,747 (48%) lived in the New Brunswick portion. In 1976, the population of the Basin was 54,809, a decrease in the 5 year period of approximately 4%. Data by river basin is presented in Table 14.

From Table 15, it is evident that 67% of the population of Matapedia County lived in the Basin in 1976. Restigouche County contained close to 50% of the basin population, and Matapedia County contributed an additional 29%. As might be expected, there has been no significant change in the composition of the basin population in the 1971-76 period.

Historically, the three counties that constitute the major portion of the basin (Restigouche in New Brunswick, Matapedia and Bonaventure in Quebec) have experienced negative population growth. Since 1961, they have declined at the following rates: Restigouche - .86%; Bonaventure - 5.2%; and a large decrease of - 32.4% in Matapedia.

FIGURE 4

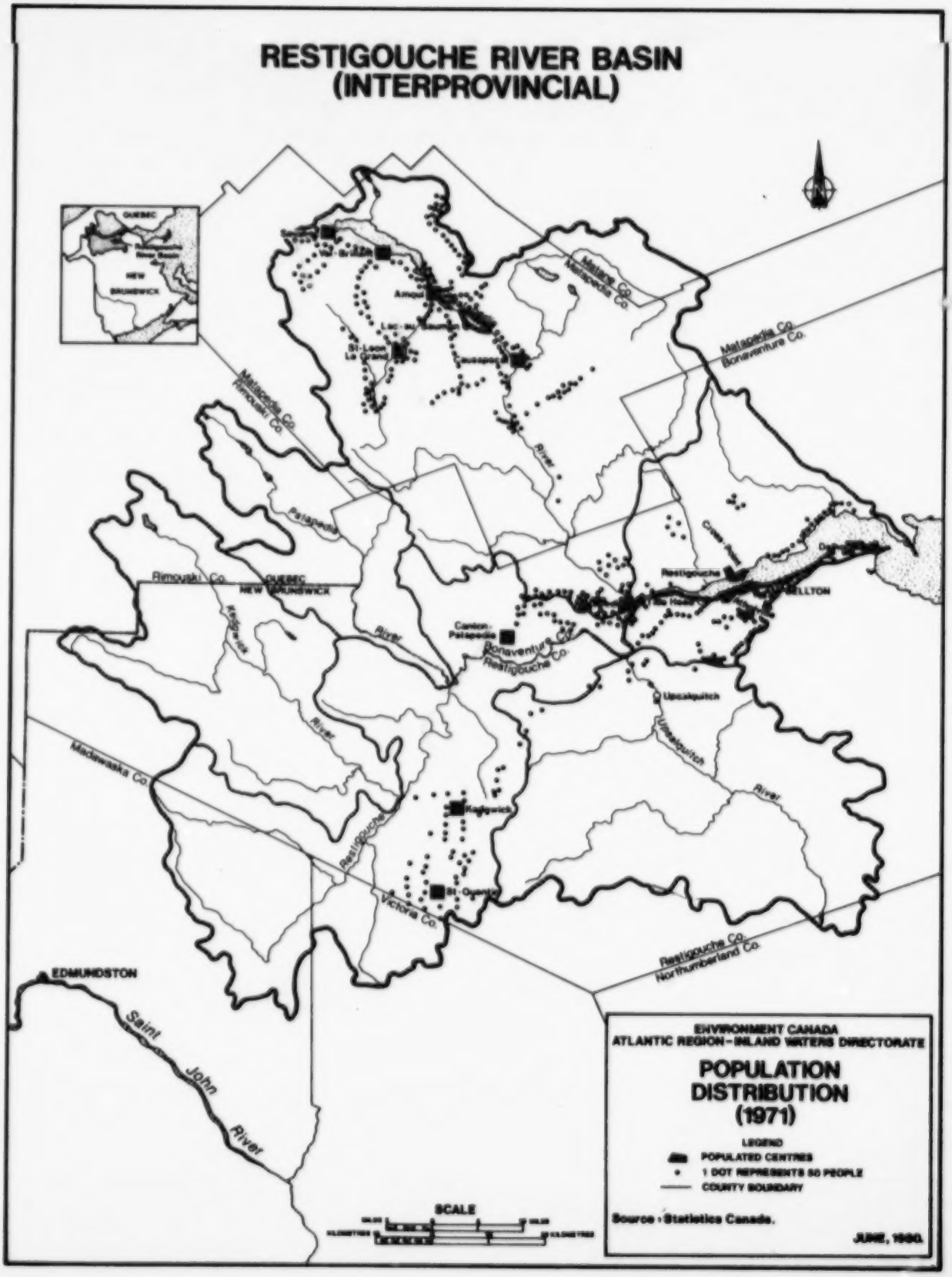
RESTIGOUCHE RIVER BASIN
(INTERPROVINCIAL)
QUEBEC
NEW BRUNSWICK
Matapedia Co
Bonaventure Co.
Matapedia Co
Restigouche Co.
Matapedia River
Restigouche River
Restigouche
CHANDLER
Canton-Patapedia
Bonaventure Co.
Restigouche Co.
Upsalquitch
Upsalquitch River
Madawaska Co.
Kedgwick
Restigouche River
Victoria Co.
Restigouche Co.
Northumberland Co.
EDMUNDSTON
Saint John River
SCALE
ENVIRONMENT CANADA
ATLANTIC REGION - INLAND WATERS DIRECTORATE
POPULATION DISTRIBUTION (1971)
LEGEND
POPULATED CENTRES
1 DOT REPRESENTS 50 PEOPLE
COUNTY BOUNDARY
Source : Statistics Canada.
JUNE, 1980.

FIGURE 4

TABLE 14

Population of the Restigouche River Basin by Sub-Basin 1971 & 1976

	1971	1976	Absolute Change	% Change
New Brunswick				
Restigouche River (mouth to Patapedia confluence)	21,123	19,511	(1,612)	(7.6)
Kedgwick	0	0	0	0
Patapedia	0	0	0	0
Restigouche River (upstream of Patapedia confluence)	5,945	6,216	271	4.6
Upsalquitch	679	1,592	913	134.5
	27,747	27,319	(428)	(1.5)
Quebec				
Matapedia	25,495	23,738	(1,757)	(6.9)
Kempt-Escuminac	4,043	3,752	(291)	(7.2)
	29,538	27,490	(2,048)	(6.9)
Restigouche River Basin	57,285	54,809	(2,476)	(4.3)

Source: Statistics Canada 1971 User Summary Tapes
Statistics Canada 1976

TABLE 15

Population of the Restigouche River Basin
1971 and 1976

	Population	Population in Basin	% of county population in Basin	County population in Basin as % of total Basin
1971				
Restigouche	41,289	27,747	67.2	48.4
Bonaventure	41,701	8,004	19.2	14.0
Matpaedia	26,856	16,754	62.4	29.3
Rimouski	64,263	4,780	7.4	8.3
		57,285		100.0
1976				
Restigouche	40,072	27,319	68.2	49.8
Bonaventure	40,363	7,160	17.7	13.1
Matapedia	23,754	16,060	67.6	29.3
Rimouski	65,088	4,270	6.7	7.8
		54,809		100.0

Source: Statistics Canada, 1971 Census of Canada 92-702
Statistics Canada, 1971 User Summary Tapes
Aggregation by River Basin derived by WP & M
Statistics Canada, 1976

As illustrated in Table 16, this negative growth rate is also characteristic of the urban centers within the counties. The City of Campbellton had a population of 9,873 in 1961 and 9,282 in 1976, a decrease of 6%. Dalhousie, the other major urban center in Restigouche County, had a population of 5,593 in 1976 compared with 5,856 in 1961. This represented a decrease of 3.7%. In 1971, the combined population of these two communities accounted for 59.8% of the population in the New Brunswick portion of the Basin and 29% of the population of the total Basin.

This trend is also evident in the two Quebec counties with the only exception being in the Town of Amqui, Matapedia County. Amqui had a population of 3,659 in 1961 and 3,923 in 1976, an increase of 7.2%. However, this rate was well below the increase for the Province of Quebec (16.8%). The Town of Causapscal, the second largest community in the county, had a population of 3,463 in 1961 and 2,726 in 1976, a decrease of 21.3%.

Although the provinces of Quebec and New Brunswick did not grow at the national rate (23.9%), their populations increased 16.8% and 11.1% respectively between 1961-1976. In New Brunswick, this growth has typically taken place in the southern part of the province, where the three largest cities are located - Fredericton, Moncton, and Saint John. The lack of opportunities in both schooling and employment have encouraged people to

Table 16

Population Data for Selected Areas 1961-1976

	1961	1966	1971	1976	Absolute Change	% Change
Canada	18,238,247	20,014,880	21,568,311	22,598,016	4,359,769	23.9
New Brunswick	597,936	616,788	634,557	644,525	66,589	11.1
Restigouche County	40,973	41,121	41,289	40,620	-353	- 0.86
Campbellton	9,873	10,175	10,335	9,157	-716	- 7.3
Dalhousie	5,856	6,107	6,255	5,593	-263	- 4.5
Quebec	5,259,211	5,780,845	6,027,764	6,141,491	882,280	16.8
Bonaventure County	42,962	43,624	41,701	40,724	-2,238	- 5.2
Matapedia County	35,586	31,433	26,856	24,063	-11,523	-32.4
Amqui	3,659	3,854	3,797	3,923	264	7.2
Causapscal	3,463	3,210	2,965	2,726	-737	-21.3

Source: Statistics Canada 1971
Statistics Canada 1976 Population Preliminary Counts

leave northern New Brunswick for the southern part of the province or for other provinces. The same is true for the Quebec portion of the basin, where a lack of education institutions and employment opportunities encourage an out-migration of people.

Although population in urban areas rose significantly in New Brunswick between 1961 and 1971 (50.6% to 56.9%), the province still differs significantly from the Canadian average, where 76.1% of the population live in urban areas. Table 17 indicates a decrease in the urban component of Restigouche County between 1971 and 1976. Bonaventure and Matapedia Counties, on the other hand, have exhibited increasing urban populations. However, both are still well below the averages for Quebec or for Canada as a whole.

The population of the basin is largely concentrated in three areas: the Atholville, Campbellton, Dalhousie area; the Kedgwick-St. Quentin area; and the Causapscal-Amqui-Sayabec area (Figure 4). There are large, sparsely populated areas from the Restigouche River estuary to Kedgwick, and from the estuary along the Matapedia River to Causapscal. In New Brunswick, those people who are not settled in the urban areas are generally located close to the coast or along Highway 11. The remainder of the New Brunswick section of the Basin is relatively uninhabited. The majority of the Quebec population in the Basin lives in the Amqui-Causpscal area around Matapedia Lake, with

Table 17

Population for Census Divisions Urban, Rural Non-Farm and Rural Farm 1971, 1976

	Restigouche				Bonaventure				Matapedia			
	1971		1976		1971		1976		1971		1976	
Total	41,290	100%	40,620	100%	43,624	100%	40,725		26,855	100%	24,065	100%
Urban	24,555	59.5	20,300	50.0	2,368	5.4	11,030		9,865	36.7	9,595	39.9
Rural Total	16,735	40.5	20,320	50.0	41,256	94.6	29,695		16,990	63.3	14,465	60.1
Non-Farm	15,580	93.1	19,940	98.1	32,288	78.3	27,915		11,195	65.9	11,670	80.7
Farm	1,155	6.9	380	1.9	8,968	21.7	1,780		5,795	34.1	2,795	19.3

Source: Statistics Canada 1971
Statistics Canada 1976

the largest concentration of people living within a 10 miles radius of Amqui. In Bonaventure County, the majority of the population lives near the coast.

All three counties are characterized by a lack of large urban centers. In 1976, neither Bonaventure County nor Matapedia County had any urban centers of over 5,000 people. Restigouche had only one center with 5,000-9,999 people (Dalhousie), and only one center with over 10,000 people (Campbellton).

TABLE 18

Population of Size Groups of Urban Center

Population	Restigouche 1971	Restigouche 1976	Bonaventure 1971	Bonaventure 1976	Matapedia 1971	Matapedia 1976
1,000- 2,499	5,855	3,515	2,455	5,440	3,105	2,905
2,500- 4,999	-	-	3,955	5,585	6,765	6,690
5,000- 9,999	6,255	5,640	-	-	-	-
10,000-29,999	12,440	11,145	-	-	-	-

Source: Statistics Canada 1971 92709
Statistics Canada 1976 92807

Table 18 illustrates the changes in urban communities in the 1971-76 period in Restigouche, Bonaventure and Matapedia Counties. There are only two communities with "town" status in Bonaventure, neither of which is located in the Basin. The Town of Amqui (3,797) and the villages of Causapscal (2,965), Sayabec (1,789), and Lac au Saumon (1,314) account for most of the urban component of Matapedia's population.

TABLE 19

Population of Communities in the Restigouche River Basin 1971, 1976

	1971	1976	Change	% Change
Restigouche				
Campbellton	10,335	9,157	(1,178)	(11.4)
Dalhousie	6,255	5,593	(662)	(10.6)
Atholville	2,108	1,834	(274)	(13.0)
Kedgwick	1,065	1,257	192	18.0
St. Quentin	2,093	2,225	132	6.3
Tide Head	797	884	87	10.9
Matapedia				
Amqui	3,797	3,923	126	3.3
Causapscal	2,965	2,726	(239)	(8.1)
Lac au Saumon	1,314	1,281	(33)	(2.5)
Sayabec	1,789	1,781	(8)	(0.5)
Val Brillant	690	665	(25)	(3.6)

Source: Statistics Canada 1971 92702
Statistics Canada 1976 Population: Preliminary Counts

Past trends show either relatively little growth or population decline in most communities, and negative growth in all three counties. Data for 1971-76 (Table 14) reveal an overall decrease of slightly less than 5% for the Restigouche River Basin. Statistics presented at the county level illustrate negative growth rates in all three counties. The majority of communities within the

Basin also exhibit negative growth. There are exceptions: Amqui grew 7.2% (1961-76), Kedgwick 18.0% (1971-76), St. Quentin 6.3% (1971-76), and Tide Head 10.9% (1971-76). However, in absolute numbers, these represent small increases relative to the basin as a whole (Tables 16 and 17). Past trends suggest that there will not likely be any significant increase in population in these areas in the near future.

6.2 Agriculture

Only a small amount of data concerning agricultural activity in the Quebec portion of the Basin was available to this study. However, data for Restigouche county as presented below is considered to be somewhat representative of conditions existing on the Quebec side.

Consistent with trends in other agricultural areas, commercial farms in Restigouche County are becoming larger in size but fewer in number. The average area per farm has increased from 40.8 hectares per farm in 1941 to 84.9 hectares per farm in 1971. However, the number of farms and total farm area have steadily decreased. In 1941, there were 1,802 farms with a total farm area of 73,572 hectares; in 1961, there were 508 farms with a total farm area of 32,233 hectares; and in 1971 there were 205 farms with 17,402 hectares in total farm area.

The 1971 Economic Classification of Farms (Table 20) lists farm size by income. It is interesting to note that slightly more than half (110 farms out of 205 in Restigouche County) report incomes of less than

Table 20

Economic Classification of Farms in the Province of New Brunswick & Restigouche County, 1971

Income	Number in Province of N.B.	Number in Restigouche County
$ 50 - $ 249	748	30
250 - 1,499	1,251	56
1,500 - 2,499	865	24
2,500 - 3,749	493	18
3,750 - 4,999	293	8
5,000 - 7,499	399	23
7,500 - 9,999	258	17
10,000 - 14,999	366	14
15,000 - 24,999	344	5
25,000 - 34,999	180	4
35,000 - 49,999	132	6
50,000 and over	138	-
Institutional	18	-
	5,485	205

Source: Agricultural Statistics 1974
N. B. Department of Agriculture

$2,500. Although this does not take all factors into consideration, it does serve to illustrate that, on an economic basis, the farms in Restigouche County are relatively small.

The percentage of the labor force employed in agriculture provides an indication of the relative importance of agriculture to each county in the study area (Table 21). Matapedia is the most agriculturally oriented, with about 15% of its labor force employed in that sector; Bonaventure has 5% and Restigouche has 2%. These figures can be compared with about 3% for New Brunswick; 3.4% for Quebec; and 5.6% for Canada.

The Canada Land Inventory has classified 84% of the land in Restigouche County as Class 4 or above. Class 4 land has moderately severe limitations that restrict the range of crops and require special conservation practices. Much of the Class 2 and Class 3 land is located in the Kedgwick-St. Quentin area.

6.3 Fisheries

The commerical fishery in the Restigouche River Basin is relatively small. Insights as to its relative importance for the New Brunswick portion of the basin economy can be obtained by a review of statistics for Restigouche County. In 1976, the value of fish landings in Restigouche County ($189,000) accounted for less than 1% of the total value of fish landings for the Province of New Brunswick. Another factor to consider is the number of people employed directly in the industry. Statistics

TABLE 21

Employment by Industry Divisions for Canada
Selected Counties and the Restigouche River Basin 1971

	Canada	New Brunswick	Restigouche County	Quebec	Bonaventure County	Matapedia County	Restigouche River Basin
Agriculture	5.58	2.98	1.83	3.36	4.96	14.7	6.75
Forestry	.86	3.0	3.98	1.01	0.38	14.1	7.84
Fishing & Trapping	.30	1.13	0.28	0.09	1.32	0	0.13
Mines (Quarries)	1.61	1.42	0.80	1.17	0.90	0.52	0.37
Manufacturing	19.79	16.3	23.5	23.14	16.3	9.55	14.50
Construction	6.24	6.87	5.88	5.51	9.40	5.45	6.34
Transport	7.78	10.11	9.34	7.92	8.46	5.45	8.42
Trade	14.71	15.41	12.09	13.58	12.10	11.19	12.77
Finance/Insurance/Real Estate	4.15	2.67	2.23	4.17	1.65	2.16	2.40
Comm. Bus. & Personal Service	23.66	22.44	26.88	24.04	23.91	23.66	26.86
Public Admin. & Defence	7.41	9.79	4.65	6.46	5.53	2.91	4.50
Industry unspecified, undefined	7.90	7.87	8.55	9.55	9.07	10.15	9.23
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Statistics Canada 1971 74-741
Statistics Canada 1971 User Summery Tapes

by county show that in 1961 Restigouche County had 183 commercial fishermen. Virtually all of these were classed as occasional fishermen (ie. fishing less than five months). By 1978, the total number of fishermena had declined to 109, of which 101 were occasional. In contrast, Bonaventure County in Quebec had 708 commerical fishermen in 1971, of which, 629 were part-time (ie. fishing between 5 and 10 months). In 1976, the total number in Bonaventure County had declined to 446. Table 21 reveals that .28% of the labor force in Restigouche County, 1.3% in Bonaventure, and none in Matapedia were employed in fishing and trapping in 1971. Fishing and trapping represented only .13% of the total labor force in the entire Basin at that time.

The Restigouche River system had been famous for Atlantic Salmon commercial and sports fishing for decades, second only to the Miramichi in the production of Atlantic salmon, before the commercial fishing ban and angling restrictions were imposed in 1972.

Five hundred lineal miles within the New Brunswick portion of the Basin are accessible to Atlantic salmon and other anadromous species of fish. Two hundred miles are available in the Restigouche and its minor tributaries, one hundred and seventy five miles in the Upsalquitch and its tributaries, and one hundred and twenty five miles in the Kedgwick, Patapedia and their tributaries. In addition, there are good supplies of spawning gravel,

nursery areas, resting pools and good quality water which are all necessary for high production of anadromous fish. It is estimated that 100,000 returning adult salmon can be supported in the Basin every year (excluding the Matapedia River).

A variety of federal Department of Fisheries projects were initiated in 1972 to assess the effects that the commercial ban and angling restrictions were having on the species. These projects have included the monitoring of ascending adult runs to determine magnitudes and timing, tagging of adult salmon to gather information on migration and timing, and electro-seining in order to estimate juvenile salmon populations throughout the river system.

Analysis of data accumulated between 1972 and 1977 shows significant improvements in fish densities. For additional information, the reader is directed to the fishery reports listed in the references.

The Charlo fish hatchery is a source of supply for stocking the Restigouche River system with young salmon. Feeding fry, yearlings and smolts are reared here. During 1975, ten thousand smolts of Restigouche origin were released above and below the mouth of the Upsalquitch and Kedgwick Rivers. In addition, other streams in the Restigouche River system were evaluated in the spring of 1977 with respect to the possibility of introducing hatchery-reared salmon.

The disease furunculosis, caused by the bacterium aeromonas, was identified in 1975 when diseased fish species were collected from the Restigouche River. The disease killed an estimated 450-500 adult salmon in 1975, 200 to 300 in 1976, and a similar quantity in 1977. Control procedures have been developed and administered in order to eradicate this disease.

In addition to the salmon fishery, significant numbers of speckled troug have historically resided in the Restigouche River system. Tomcod, smelt, clams and lobster are found in the estuary. Information is sparse on the economic significance of these fish species.

6.4 Forestry

The Restigouche River Basin has abundant forests, most of which are located in the St. Lawrence Forest Region. Part of the Quebec portion of the Basin lies in the Gaspe area of the Boreal Forest Region.

Large quantities of coniferous trees are found in the Basin, with spruce being the predominant species. Other types of softwoods represented are balsam fir, pine, cedar, hemlock and larch. Deciduous varieties consist mainly of birch, maple, beech and poplar.

Most economic activity in the Basin is based on the forestry resources. Forestry, when combined with the manufacture of forest products, is the largest economic activity and major source of employment in the Basin. In all likelihood, the future economic health of the region will continue to depend to a large extent on events

occuring in these forest-based industries.

In terms of employment, there were 1,281 people, (7.84% of the labor force) in the Basin employed directly in forestry in 1971. This compared with 3.98% in Restigouche County, 6.38% in Bonaventure County, and 14.1% in Matapedia County. However, these figures do not include related wood product industries such as the pulp and paper mills which are the largest employers in Restigouche County.

Two major pulp and paper mills are located in the estuary area. New Brunswick International Paper Ltd. in Dalhousie, employed between 1,173 and 1,250 in 1976. Fraser Companies employed 220 people at their Atholville Mill. Fraser Companies also have a sawmill at Kedgwick which employed 180 people. At the present time, the future of the pulp and paper mills is uncertain. Higher transportation costs of both raw materials and finished products, potential shortages of wood supply, a volatile world market, and outdated equipment all affect the economic health of the industry.

The "Report of the Industrial Inquiry Commission on the Pulp and Paper Industry 1972", presented a bleak picture of the industry. At that time, New Brunswick was second only to the Province of British Columbia in terms of its dependence on the pulp and paper industry. None of the eleven mills operating in New Brunswick made a profit in 1971, and conditions were not expected to

improve in 1972.

The future of the Fraser Mill in Atholville even at that time was in doubt. The Inquiry stated that "the mill is barely carrying its fixed costs, and when market conditions improve, it should make a modest contribution to profits". The Canadian International Paper Mill at Dalhousie has also had problems. Although sufficient investments had been made to maintain productive capability, it was doubtful whether any substantial new capital investment for major expansion could be justified. The Commission further stated that "the primary uncertainty is associated with continuing availability of Quebec wood, loss of which could adversely affect the mill's economic viability", and that "CIP's mill at Dalhousie has marked time for many years".

The future of the forest industry in the Basin seems, at best, uncertain. Forest productivity is limited by a restricted productive forest land base. The Canada Land Inventory classified 84.5% of the productive land in the County of Restigouche as class 4 or 5. Class 4 land is land having moderately severe or severe limitations to the growth of commercial forests.

In the Quebec section of the Basin, the emphasis in the forest industry is on supplying local sawmills, and on producing forest-related products in a variety of small manufacturing operations.

Because of the ailing pulp and paper mills, the region will probably have to develop new areas in which to use the forestry resources if it is to maintain current employment levels in this sector.

6.5 Manufacturing

Economic activity in the Restigouche Basin is based on the natural resources of the area, especially forestry. Employment is concentrated in the forestry and manufacturing sectors, with the pulp and paper mills being the major manufacturing concerns and largest employers in the Basin.

A review of manufacturing concerns in the Basin illustrates the importance of the pulp and paper industry to the economy. Major manufacturing concerns in the Restigouche County portion of the Basin are listed in Table 22 and provide an indication of the relative importance of each to the Basin economy in terms of employment.

It is interesting to note that of the 15 firms listed, 11 are forestry related (pulp and paper, wood, furniture and fixtures). There are three firms in the food and beverage industry and one firm (C.I.L. in Dalhousie) manufactures chemicals and chemical products. The food and beverage firms, Northern Meat Packers', Gray's Velvet Ice Cream, and Naudeau Beverages cater largely to local markets.

TABLE 22

Major Manufacturing Firms With Over 20 Employees in the N. B. Portion of the Restigouche River Basin (1976)

Firm	Location	Industry	Employees
Fraser Companies	Atholville	Paper & Allied	220
Northern Meat Packers	Campbellton	Food & Beverage	45
Gray's Velvet Ice Cream	Campbellton	Food & Beverage	32
Nadeau Beverages	Campbellton	Food & Beverage	35-40
T.R. MacKenzie Co. Ltd.	Campbellton	Wood Industries	40
N.B. International Paper	Dalhousie	Paper & Allied	1173-1250
Canadian Industries Ltd.	Dalhousie	Chemical & Chemical Products	
Northeast Pine	Glencoe	Furniture & Fixtures	
Fraser Companies	Kedgwick	Wood Industries	180
Kedgwick Lumber	Kedgwick	Wood Industries	20
Belanger, Oscar	Saint Arthur	Wood Industries	60-100
N.A. Forest Products	St. Quentin	Wood Industries	20
Hardwood Industries	St. Quentin	Wood Industries	20
N.A. Forest Products	St. Quentin	Wood Industries	45
Pre Habitat Env.	St. Quentin	Wood Industries	14-25

Source: N. B. Directory of Manufacturers & Products 1976

Other manufacturing concerns with less than 20 employees are summarized by industry in Table 23. Twelve of these firms are forest-related, six are food and beverage, and the remaining 27 represent a variety of industries, including pastry shops, ready-mix, welding shops and printing and publishing operations, serving largely local markets. The majority of these firms are located in the Atholville-Campbellton-Dalhousie area.

Very little growth has taken place in the manufacturing sector over time. For example, it has been reported[1] that there were 36 establishments with 1,949 employees in Restigouche County in 1961. In 1972, there were 31 establishments with 2,083 employees, a decrease of five in the number of firms and a small increase of 134 employees (6.9%). The City of Campbellton has also experienced very little growth in the manufacturing sector. In 1961, there were 13 establishments with 173 employees. In 1970, there were 12 establishments with 184 employees; and in 1972, 13 firms employing 494.

Various reasons are given for the lack of growth in the manufacturing sector with the major ones being high transportation costs, and the lack of large markets.

As of 1979, there was not one dominant industry in the Quebec portion of the Restigouche Basin. However, what secondary industry did exist was once again based

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1. Principal Statistics of the Manufacturing Industries, Statistics Canada.

TABLE 23

Small Industries by Number of Employees in the N. B. Portion of the Restigouche River Basin, 1976

Industry	# of Firms	Total No. of Employees
Food & Beverage	6	36
Metal Fabrication	4	19
Non-metallic Mineral	4	26
Wood	10	79
Textile	1	18
Furniture & Fixtures	2	23
Printing & Publishing	5	40
Electrical	1	13
Chemical & Chemical Products	1	3
Transportation Equipment	1	3

Source: N. B. Directory of Manufactures & Products 1976

Table 24

Industry in the Matapedia Basin 1970

Community	Industry
Amqui	Dairy (two firms) Feed Manufacturing (two) Bakery (two) Sash & Door Printing & Bookbinding (two) Publishing Ornamental & Architectural Metal Works Machine Shop
Causapscal	Sawmills (three) Bakery Printing, Bookbinding Machine Shop
Sayabec	Bakery Dairy Sawmills (two)
Lac au Saumon	Sawmill Planing Mill
Val Brilliant	Dairy
St. Alexis de Matapedia	Bakery
Mann Settlement	Sawmill
St. Florence	Sawmills (two)
St. Benoit-Joseph-Labre	Dairy Sawmill
St. Jacques	Sawmill
St. Leon le Grant	Sawmill Bakery

Source: Quebec Bureau of Statistics 1970

on the forestry resource. Enterprises in this area consisted primarily of small manufacturing concerns, numerous sawmills, bakeries, dairies, printing and publishing shops, etc. (Table 24).

7. WATER SUPPLY AND WASTE DISPOSAL

7.1 Water Supply

In 1971, there were approximately 12,141 households in the Restigouche River Basin of which 5,973 were located in Quebec and 6.168 were located in New Brunswick. Table 25 illustrates the source of water supply for these households. It should be noted that the "well on property" data refers only to individual household wells, and does not include central groundwater supply systems.

TABLE 25

Source of Water Supply, Restigouche River Basin 1979

	Quebec		New Brunswick		Total	
	No.	%	No.	%	No.	%
Households	5,973	100.0	6,168	100.0	12,141	100.0
Source:						
Municipal/Private	2,995	50.1	4,439	72.0	7,434	61.8
Well on Property	2,475	41.4	1,297	21.0	3,778	31.1
Other: spring, river, creek	460	7.7	443	7.2	903	7.4

Source: Statistics Canada 1971 User Summary Tapes
Aggregation by River Basin derived by WP & M, IWD, Environment Canada

In the New Brunswick portion of the Basin, 72% of the households were serviced by municipal or private

systems in 1971. The Restigouche River itself does not offer an economical source of potable water to the communities of Campbellton and Dalhousie. The river is saline for 20 miles upstream of Dalhousie and is used only as a source of industrial water supply.

Information recorded in the National Inventory of Municipal Waterworks and Wastewater Systems in Canada (Table 26), illustrates that all major communities in Restigouche County have municipal systems with all of their population serviced. These six communities represent 81.6% of the 1971 population of the New Brunswick portion of the Restigouche River Basin. The Maritime Provinces Water Resource Study stated in 1969 that "the Campbellton Study Area is fortunate in having ample water resources which will require very little development to supply all communities in the area at least to the turn of the century". An examination of current population, household, and industrial development data in this area since 1969 shows very little change. The population of the Basin, the county and most of the major communities have declined (Table 14 and 15). No significant new industrial development has taken place, and present indications are that no significant changes will take place in the near future.

In cooperation with the Town of Dalhousie, the NBIPC pulp and paper mill draws its water supply from the Eel and Charlo Rivers which are situated outside the

TABLE 26

Waterworks Systems for Communities in Restigouche County 1977

Facility	Current Population	Responsibility	Sources	Average Flow	Design Flow	Population Served
Dalhousie	5,616	Municipality	surface/ shared	1,296	1,400	5,616
Atholville	1,834	Municipality	ground	494	648	2,091
Campbellton	9,241	Municipality	surface	1,850	3,000	9,241
Tide Head	842	Municipality	ground	150	300	848
Kedgwick	1,228	Municipality	surface	90	350	1,228
St. Quentin	2,300	Municipality	surface	348	618	2,300

Source: National Inventory of Municipal Waterworks and Wastewater Systems in Canada 1977

Restigouche River Basin. If any large increase in demand were to occur in the future, it appears that the Charlo River would be the primary source used to satisfy this increase.

Fraser's pulp mill at Atholville draws most of its process water requirements, about 18 mgd (Imp), from an intake one-half mile upstream of Tide Head. During periods of high river flows some quality problems have been experienced due to silt.

The water requirements for any pulp production expansion would be satisfied by the Restigouche River, without any significant demand placed on the existing public utility.

A significantly smaller percentage of households in the Quebec portion of the basin are connected to public systems (Table 25). The small size of the communities and the scattered distribution of the population make it more difficult for communities to finance and maintain municipal systems. Table 27 lists water systems in the Quebec portion of the Basin.

The major water supply concerns in the Matapedia Basin revolve around domestic water use. Industry in the Matapedia Basin is on a small scale and there are few industrial users. However, because the Quebec portion of the Basin has experienced a decline in population between 1971 and 1976 of close to 7% (Table 14), it is not likely that domestic water demand will increase dramatically in the near future.

TABLE 27

Waterworks Systems in the Quebec Portion of the Restigouche River Basin 1977

Municipality	Facility	Responsible Authority	Source	Current Population	Population Served
Point a la Croix	chlorination station	municipality	surface	1,650	1,000
Matapedia	pumping station	municipality	surface	975	700
	Matapedia	municipality	surface		10
St. Alexis	pumping station	province	ground	1,066	288
Saint Francois	pumping station	municipality	ground	1,200	600
Ste. Florence	gravity system	province	surface	660	60
	gravity system	municipality	surface		15
	gravity system	municipality	surface		35
	gravity system	municipality	surface		40
Causapscal	pumping station	municipality	ground	3,000	3,000
St. Alexandre	pumping station	municipality	surface	300	25
Lac au Saumon	chlorination station	municipality	surface	1,350	1,225
Amqui	pumping station	municipality	ground	3,700	4,500
Saint Zenon du Lac	saint zenon du lac	private	surface	625	25
Sal Brillant	pumping station	municipality	surface	680	680
Ste. Irene	pumping station	private	ground	390	75
Sayabec	Sayabec (no other information)	municipality	surface	2,100	2,100

Source: National Inventory of Municipal Waterworks and Wastewater Systems in Canada 1977.

7.2 Waste Disposal

The 1971 Statistics Canada User Summary Tapes disaggregated sewage disposal data into (1) connection to public sewer, (2) septic tank, and (3) other (e.g. cesspool, pit, etc.). The "other" category is assumed here to include private collection systems such as trailer park lagoons. Data for the Basin is summarized below in Table 28.

TABLE 28

Method of Sewage Disposal, Restigouche River Basin 1971

	Quebec		New Brunswick		Total	
	No.	%	No.	%	No.	%
Households	5,973	100.0	6,168	100.0	12,141	100.0
Method of Sewage Disposal						
Public Sewer	2,310	38.7	4,161	67.5	6,471	53.3
Septic Tank	470	7.9	665	10.8	1,135	9.4
Other-Cesspool	3,130	52.4	1,370	22.2	4,500	37.1

Source: Statistics Canada 1971 User Summary Tapes
Aggregation by River Basin derived by WP & M, IWD, Environment Canada

The communities are generally larger in the New Brunswick portion of the Basin. For example, the majority (60% in 1971) of the population of the New Brunswick part of the basin live in the communities of Campbellton and Dalhousie. Larger communities normally have a larger financial capability to finance and operate waste water systems. Therefore, a greater percentage of the population in Restigouche County are connected to

public sewer systems. The New Brunswick portion has almost twice as large a proportion of households connected to public sewer systems (65.5% compared to 38.7% in Quebec). Current data is presented for communities in Restigouche County in Table 29.

Domestic and industrial wastes are both discharged into the Restigouche estuary. As indicated in Table 29, most of the communities in the New Brunswick portion of the basin have some form of treatment facilities. The City of Campbellton has recently (October 2, 1978) opened a new water and sewage system. Although wastewater systems in this part of the basin are gradually being upgraded, the pulp and paper mills located here still discharge waste into the river.

The Canadian International Paper Company mill, and the CIL chlor-alkali plant, at Dalhousie, as well as Fraser's pulp mill at Atholville discharge waste into the Restigouche River. No information is available concerning the discharge of waste from the Allied Chemical Alum plant at Dalhousie.

The newsprint mill at Dalhousie and the kraft pulp mill at Atholville provide primary treatment (solids settling). One-third of the effluent from the Atholville mill is subjected to secondary treatment (aeration). Waste water from the chlor-alkali plant is treated to remove mercury.

TABLE 29

Wastewater Systems in Restigouche County 1977

	Current Pop.	System	Sewer By-Law	Sewer Design Capacity	Treatment Plants	Dis-infection	Pop. Served by Treatment Facility
Dalhousie, Town	5,616	Yes	No	5,616	1	Yes	5,616
Altholville, Town	1,834	Yes	No	1,834	1	Yes	1,834
Campbellton, City	9,241	Yes	-	10,422	-	No	None
Tide Head, Village	842	Yes	No	842	-	No	None
Kedgwick Village	1,228	Yes	No	1,228	1	No	1,228
St. Quentin	2,300	Yes	No	2,300	1	Yes	2,300

Source: National Inventory of Municipal Waterworks and Wastewater Systems in Canada 1977.

EPS, Maritime Region, has provided the following (1979) information on the discharge of industrial wastes into the Restigouche River.

TABLE 30

Industrial Wastes Discharged into Restigouche Estuary

	NBIPC Dalhousie	Fraser's Mill Atholville	CIL Plant Dalhousie
BOD_5 (lbs/day)	55,000	223,000	-
Suspended solids (lbs/day)	38,000	77,000	-
Mercury (lbs/day)	-	-	0.07

All plants comply with regulation standards with respect to the discharge of liquid and solid wastes.

No recent detailed studies have been done regarding any ill effects that water borne wastes exert on either resident or migratory fish. However, complaints have been registered in the past concerning polluted beaches along the shores of the estuary. Furthermore, with certain combinations of tides and effluent discharges, pollution has risen to undesirable levels.

The closure of shell fisheries because of bacterial pollution has been a common occurrence. Untreated domestic waste is a large source of bacterial pollution. The Town of Dalhousie and the City of Campbellton have been the biggest polluters in this regard. However, the installation of modern sewage treatment plants at Dalhousie and Atholville, plus the proposed

TABLE 31

Wastewater Systems in the Quebec Portion of the Restigouche River Basin. 1977

Municipality	System	Facility	Responsibility	Sewage By-Law	Disin-fected	Treatment Plants	Population Current	Population Served
Pointe a la Croix	Yes	purification plant	Municipality	No	Yes	1	1,650	1,000
Matapedia	Yes	purification plant	Municipality	No	Yes	1	975	700
St. Alexandre	Yes	septic tank	Municipality	No	No	1	300	25
Val Brillant	Yes	sewage treatment plant	Municipality	No	No	1	680	680
Lac au Saumon	No	-	-	No		-	1,350	-
Amqui	Yes	-	-	No		-	3,700	3,700
Sayabec	Yes	-	-	No		-	2,100	2,100

Source: National Inventory of Municipal Waterworks and Wastewater Systems in Canada. 1977.

treatment plant for Campbellton should solve this particular problem.

In the Quebec portion of the Basin, relatively fewer homes (38.7%) are connected to public sewage systems (Table 28). Over half of the households (52.4%) use other methods such as cesspools or pit disposal. The small size of these communities makes it difficult for them to finance and operate community systems, and as a result, much of the sewage is discharged untreated. Of the communities that do have public sewage systems, few have treatment facilities (Table 31).

Because of its relatively small scale, industrial production in the Matapedia Basin does not pose major disposal problems for the water resources of the area.

8. FLOODING

Most of the flooding in the Restigouche Basin has occurred during April and May and is caused by heavy rains, melting snow, or, in some instances, is aggravated by ice and debris clogging the constrictions in the watercourses.

Disruption of traffic caused by highway inundation, and train movements being delayed by washouts have occurred frequently. Walker Brook at Campbellton, low lying areas around Wyers Brook and along the main stem of the Restigouche River have also been flooded often. The pulp mill at Atholville has been forced to shut down twice because of flooding. Many cords of pulp-

FIGURE 5

wood were reported lost during at least two flooding events. Damages to the Restigouche Hotel at Matapedia, the closing of schools, a few people being evacuated from their homes, and the loss of some cattle, have been reported several times.

In summary, the floods which have occurred from 1923 to 1974[1] caused property damage and inflicted personal hardships on residents of the Basin. However, less severe damage was caused by flooding than in many other parts of the province, notably in the Saint John River Basin.

Six sites in the New Brunswick portion of the Basin have been identified as requiring flood risk mapping under the federal-provincial Flood Damage Reduction Program. These sites are: (1) Campbellton waterfront, (2) Campbellton-Atholville (Walker Brook), (3) Val d'Amour (Walker Brook), (4) Flatland - Tide Head, (5) Upsalquitch-Robinsonville, and (6) Wyers Brook (Restigouche River). Figure 5 illustrates the location of the Walker Brook and Campbellton City flood plains.

Flooding on the Campbellton waterfront occurs almost exclusively during spring freshets when tides are abnormally high, and is intensified by wind-driven ice packs (backwater effect). Severe erosion problems have occurred in the past as evidenced by the protective crib-

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1. Flooding Events in New Brunswick, An Historical Perspective.

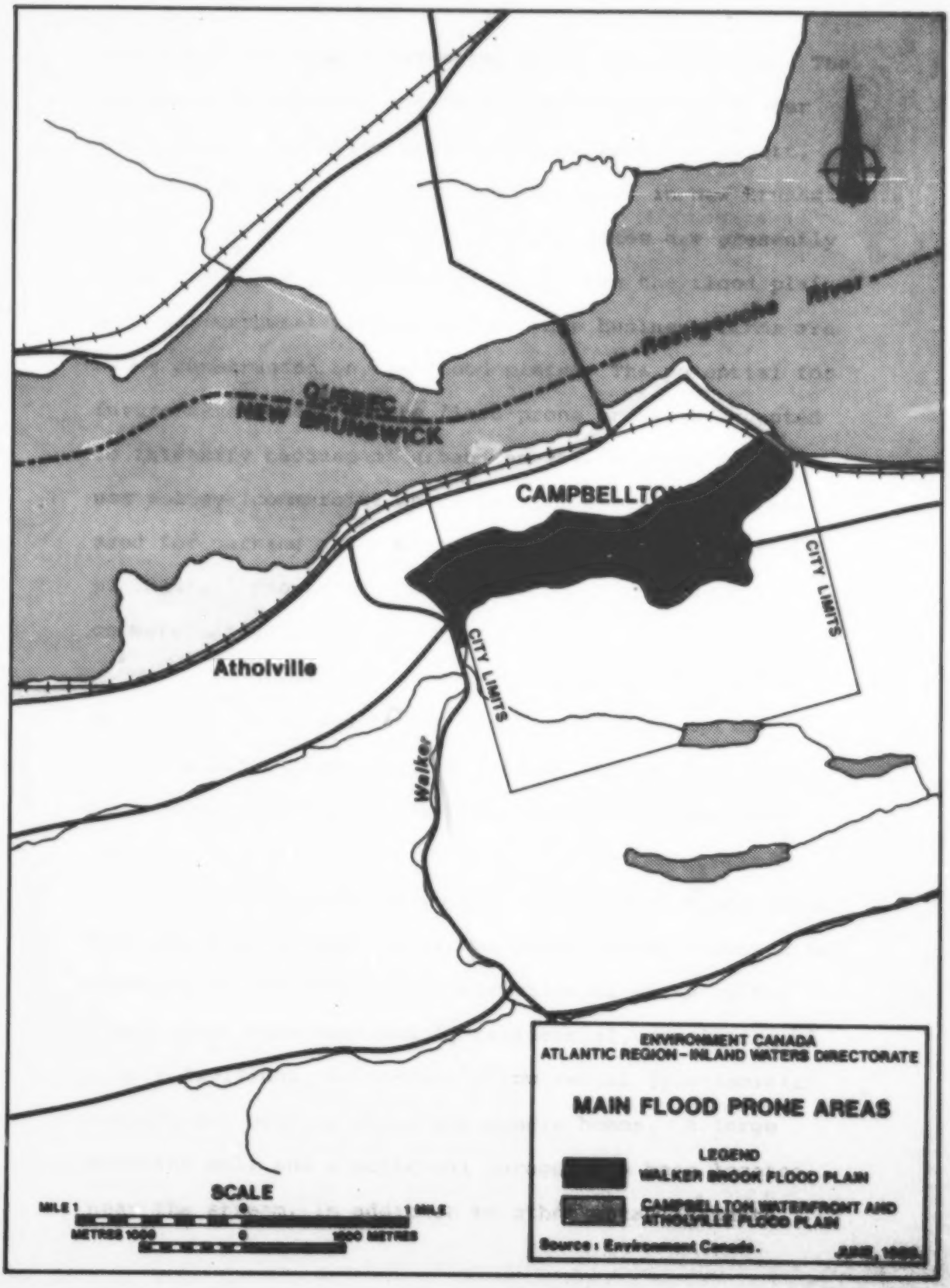
QUEBEC
NEW BRUNSWICK
Restigouche River
CAMPBELLTON
CITY LIMITS
CITY LIMITS
Atholville
Walker
SCALE
MILE 1
0
1 MILE
METRES 1000
0
1000 METRES
ENVIRONMENT CANADA
ATLANTIC REGION - INLAND WATERS DIRECTORATE
MAIN FLOOD PRONE AREAS
LEGEND
WALKER BROOK FLOOD PLAIN
CAMPBELLTON WATERFRONT AND ATHOLVILLE FLOOD PLAIN
Source : Environment Canada.
JUNE, 1980

FIGURE 5

FIGURE 5

work which has been constructed along the shoreline. The following information regarding the Campbellton-Walker Brook flood plains has been extracted from the report, "Flood Risk Mapping, Field Reconnaissance in New Brunswick".

In some instances, landfill sites are presently being developed at elevations lower than the flood plain. Modern government offices and private business firms are being constructed on the flood plain. The potential for future development in the flood-prone areas is expected to intensify because of urban renewal, changes in land-use policy (commercial development replacing areas now used for parking and recreation) and further extension of landfill projects to accommodate the impetus for commercialization.

Flooding in the Campbellton-Atholville-Walker Brook area is caused by heavy run-off during spring freshets and regional storms. It is further increased by under-designed culverts and undersized bridge openings.

Encroachment on to the Walker Brook flood plain has been accelerating in recent times and is expected to continue in the future. Construction of works on the flood plain have been mainly residential, consisting of single dwellings, multi-family low rental (provincially subsidized) housing units and mobile homes. A large shopping mall and a municipal garage have been located near the stream, in addition to other establishments.

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